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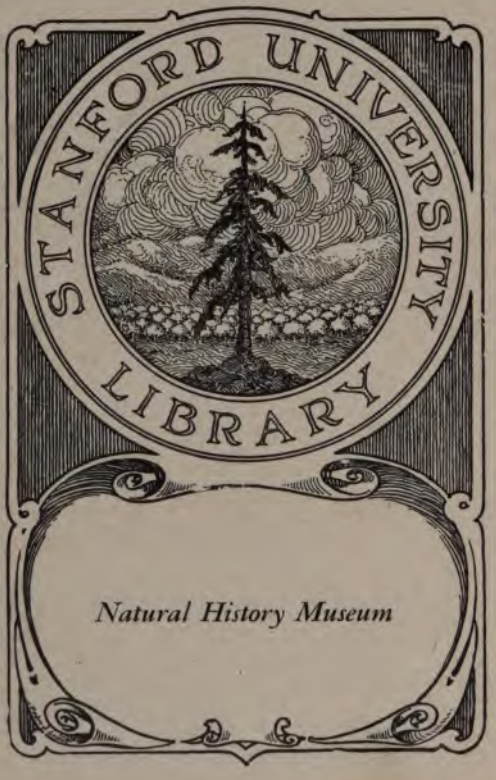


*Natural History Museum*

# MEMOIRS

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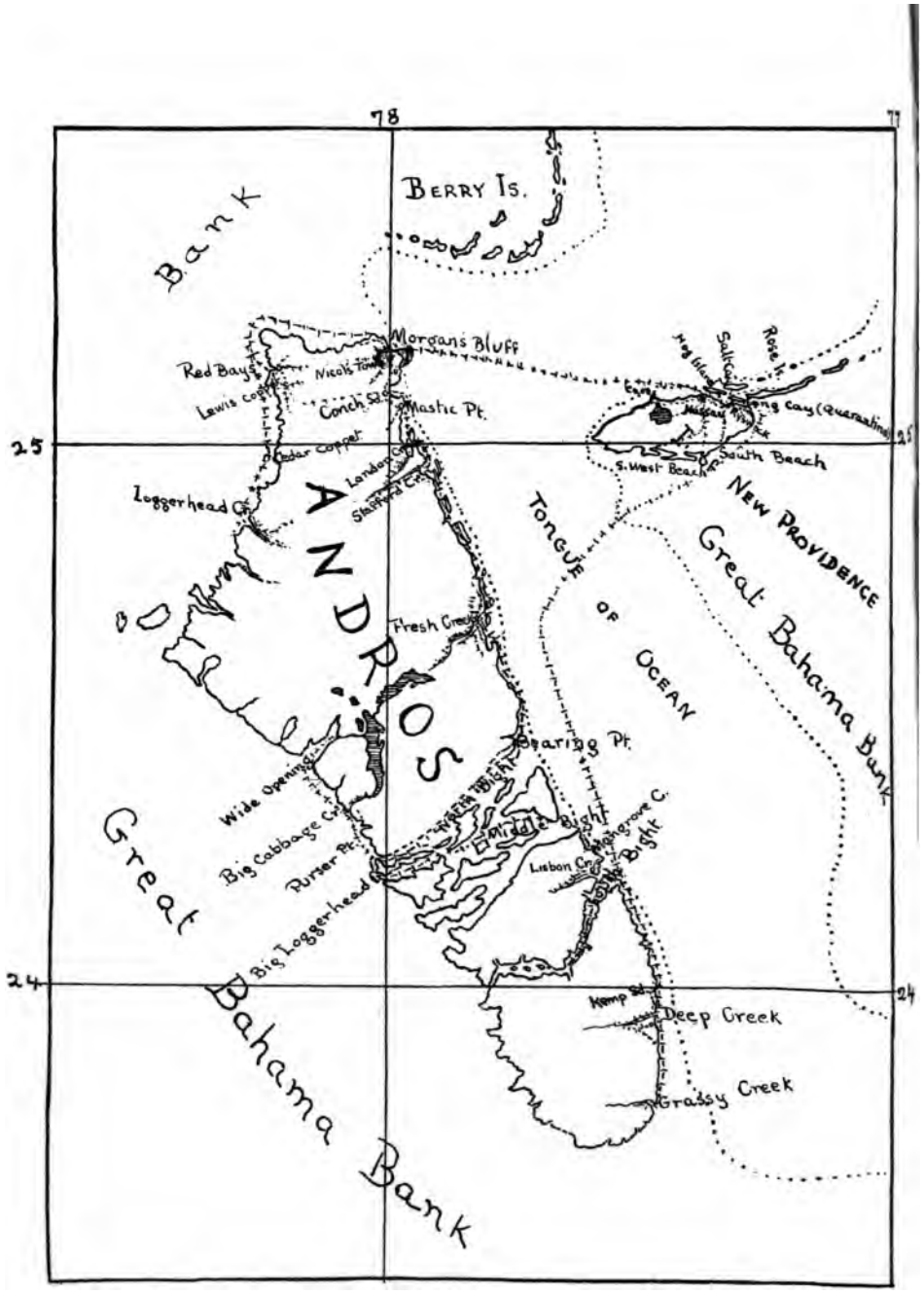


BAHAMA ISLANDS

. . . . . Edge of Bank.

I-I-I-I-I-I-I-I Route of Exploration.

# FLORA OF NEW PROVIDENCE AND ANDROS

## WITH AN ENUMERATION OF THE PLANTS COLLECTED BY JOHN I. NORTHROP AND ALICE R. NORTHROP, IN 1890

By Alice R. Northrop

### Introduction

During the latter part of 1889, a report of the work in the Bahamas of the Danish botanist, Baron Eggers, was received at the herbarium of Columbia University and with it a letter from Sir William Thiselton-Dyer, expressing a hope that American botanists would continue the exploration. My husband, Dr. John I. Northrop, Instructor in Biology at Columbia University, was at that time contemplating a southern trip for the purpose of studying and collecting marine invertebrates. Sir William Thiselton-Dyer's letter was brought to his notice and the result was that a Bahaman trip was planned with both objects in view. Over six months were spent on the islands, from January to July, 1890. Of this time two months were passed on the island of New Providence, where the time was mainly taken up with zoölogical work, and the remainder on Andros, where the most interesting plant collections were made.

In order to understand properly the distribution of the plants and the relations of the flora, it will be necessary to give a general idea of the position and conformation of the two islands visited. New Providence is one of the smaller islands of the group, being only about twenty miles long and seven wide. It lies on the northern edge of a portion of the Great Bahama Bank. Nassau, the seat of government and a well-known health resort, is situated on the slope of a ridge that runs along the northern shore of the island. The highest point of this ridge, Fort Fincastle, is about

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one hundred feet above sea-level. From here one has an excellent view of the city and harbor, the latter protected by the narrow outlying cays known as Hog Island, Long Island or Quarantine, and farther seaward, Salt Cay. In the opposite direction, a low, level country, covered with trees and dotted here and there with cocoanut groves, stretches away to the Blue Hills.

Roughly speaking, the physical features of New Providence may be described as a rocky ridge, about one hundred feet above sea-level at its highest part, extending along the north side and covered with a growth of angiospermous trees and shrubs; a low central plain out of which rises a second ridge, the Blue Hills, is like the first, but narrower and lower; then a slightly undulating region covered with the Bahama pine, extends to the low and swampy south shore. The depressions of the central plain are occupied by two quite large bodies of brackish water, Lake Cunningham and Lake Killarney. The latter is the larger and contains numerous mangrove islets.

The rock of both islands is of aeolian formation; it is very hard at the surface but becomes so much softer below that it is sawn into blocks for a building stone. The surface erosion is most striking and characteristic. In many places the rocks are fairly honeycombed with holes, pits and cavities of all sizes; often sharp, jagged points project, making walking extremely difficult. The largest of the pits are locally known as "banana holes" because they usually contain considerable earth in which the people plant their bananas. They vary greatly in size and shape; the majority being probably from eight to ten feet in diameter; they are occasionally twenty feet in depth but are usually much shallower. Their sides are often lined with delicate ferns, many of which grow nowhere else.

There is little or no soil. Mark Catesby, the first naturalist to visit the islands, wrote in 1754: "The Bahama Islands may not only be said to be rocky but are in reality entire Rocks, having the surface in some Places thinly covered with a light Mould which in a series of Time has been reduced to that Consistence from rotten Trees and other Vegetables. Thus much of the Character of these Islands being considered, one would expect that they afforded the disagreeable Prospect of bear Rocks: But on

the Contrary they are always covered with perpetual Verdure and the Trees and Shrubs grow as close and are as thick cloathed with Leaves as in the most luxuriant Soil." In some places the soil is reddish and this is considered the most fertile.

Six weeks of our stay were spent at Ryswick, a country place that we rented on the shore about three miles east of Nassau. Although the greater part of this time was given to the zoölogical work, still between times we collected over two hundred species of plants, crossing the island several times and exploring it in many directions. The collection, of course, included many cosmopolitan weeds and introduced plants that were found in Nassau and its environs. Among the latter, growing commonly about the city were the glossy-leaved almond tree (*Terminalia Catappa*), the graceful Spanish cedar (*Casuarina equisetifolia*), the buttressed ceiba or silk-cotton tree, the sand-box tree (*Hura crepitans*), and the beautiful flamboyant (*Poinciana regia*) with its fern-like foliage.

Having completed the zoölogical work that had been planned, we made a diligent study of the chart, and finally decided to visit Andros next as the largest and least known of the islands and the one from which no botanical collections had ever been made. Although the nearest part of Andros is only twenty-five miles from New Providence, we could get but little information concerning it until we met Mr. Alexander Keith, of Edinburgh, who had a sisal plantation on Andros. To him we were indebted for many favors both at this time and later. A "norther" delayed our sailing for ten days, but we finally reached Andros March 14, and remained there until July 3.

Andros is by far the largest island of the group, being nearly one hundred miles long and forty or fifty wide in its broadest part and having an area of over nineteen hundred square miles. It is in reality not one island but a group of islands, the larger northern portion being separated from the southern and central parts by shallow channels known as "bights." There is a northern, a middle and a southern bight but they are so filled with cays that the whole archipelago, as it might be termed, is called by the general name of Andros. In its prominent physical features, Andros resembles New Providence, although its greatest length runs north

and south instead of east and west, as in the case of New Providence. It has a rocky ridge extending along the east coast, except at the extreme southern end, extensive pine barrens in the interior and low mangrove flats on the opposite side. On Andros, however, the last cover a much greater portion of the island and constitute its most characteristic feature. The local name of this region is "swash," a most appropriate term, as in wet seasons it is half under water. The pine belt is always spoken of as the "pine-yard" and the hardwood growth on the rocky, elevated portion is called "the coppet."

The pines are most abundant on the northern part of the island and at the extreme southern end below Grassy Creek where the rocky ridge is wanting, there were said to be no pines. None could be seen from the shore but we did not cross the island so far south. At Nicol's Town, the most northerly settlement, the belt of coppet is only about three quarters of a mile wide; the pine-yard then begins and extends to the swash on the other side. At Conch Sound, a few miles south of Nicol's Town, the pines come down to the eastern shore, but below Mastic Point, the next settlement, the belt of coppet becomes much wider. The swash is more extensive than the other two regions put together and covers hundreds of square miles; next in extent are the pine barrens, while the coppet is scarcely more than a comparatively narrow belt or fringe along the east coast. The pines sometimes extend in long points far out on the swash.

Numerous creeks drain the island, the majority being on the east side; in very wet seasons there is said to be water communication between those of the east and west side. The creeks are generally narrow and winding but they occasionally spread out into lake-like expansions in the interior. The largest of these lakes are on the west side near Wide Opening. A number of the creeks are fresh at their source.

All the settlements are on the east side with the exception of a small one at Red Bays on the northwestern end of the island. Nicol's Town is one of the largest and when we were there had about three hundred inhabitants. At the time we visited Andros there were but seven white people on the entire island. There were no roads and communication between the settlements was

entirely by water, the reef making a safe channel for small boats all along the eastern coast. The west coast is exceedingly shallow, so much so that our boat, drawing only about two feet of water, had sometimes to anchor a quarter of a mile from the shore. Even at the edge of the Great Bahama Bank, sixty or seventy miles further west there are but three or four fathoms of water. The only visitors to this coast are the "spongers."

During the four months spent on Andros, we explored it quite thoroughly, crossing it several times and almost circumnavigating it, making stops at the various settlements on the way or camping out on the west side where there were no settlements. From one to six weeks were spent at each of the following places: Nicol's Town, Conch Sound, Mastic Point, Fresh Creek, Lisbon Creek, and Deep Creek on the east side, and Red Bays on the west. We sailed through the northern and middle bights and partly through the southern and penetrated the following creeks, most of them to the head of navigation for a rowboat: London, Stafford, Fresh, Lisbon, Deep, and Grassy creeks on the east; Loggerhead and Big Cabbage creeks and Wide Opening on the west.

## BOTANICAL REGIONS

The following botanical regions, each with markedly characteristic plants, were well defined on both islands: First, the maritime or coast flora of the northern side of New Providence and the east side of Andros. These shores were rocky with scattered sandy beaches. The following plants were common on both islands: The sea-grape (*Coccolobis uvifera*), the buttonwood (*Conocarpus erecta*), the sandfly bush (*Rhacicallis rupestris*), and *Strumfia maritima*. The wild sapodilla (*Mimusops dissecta*), Joe-bush (*Jacquinia Keyensis*), *Cordia Sebestena*, *Borrichia arborescens*, and the ram's horn (*Pithecolobium Unguis-cati*) were always found near the shore, while on the sandy beaches flourished the cocoa-plum (*Chrysobalanus Icaco*), *Scaevola Plumieri*, *Suriana maritima*, *Tournefortia gnaphaliodes*, the bay lavender (*Ambrosia hispida*), *Euphorbia buxifolia*, the widely distributed *Salicornia ambigua*, *Sesuvium Portulacastrum*, *Cakile aequalis*, and the horse-bean (*Canavalia obtusifolia*).

Second, the "coppet," or growth of angiospermous trees and shrubs found on the more elevated parts of the islands and on the

rocky ridges. The highest elevation on either island was about one hundred feet, but the ridge was in most places considerably lower than this. On Andros, the highest point was near the center of the island, at the mouth of the northern bight, marked as Salvador Point on the charts but locally known as Bearing Point. The surface erosion was much more marked on Andros than on New Providence. In some places the rock was honeycombed with pits of all sizes, in others it was covered with sharp, knife-like projections. Banana holes were far more numerous. On both islands the elevated ridges, covered with the "coppet," showed the greatest amount of erosion. The trees most commonly met with were the gum elemi (*Bursera Simaruba*), the poison wood (*Metopium*), the wild cassada (*Dipholis salicifolia*), the horseflesh (*Lysiloma paucifoliola*), and the Madeira (*Swietenia Mahogani*). As a rule the trees were comparatively small, not more than a few inches in diameter. The largest and tallest were seen in what was called the "high coppet" near Deep Creek, Andros. One horseflesh there measured five and a half feet in circumference at a distance of four feet from the ground; another six feet four inches, while the largest mahogany seen was between two and three feet in diameter. Common among the underbrush were the cockspur thorn (*Pisonia aculeata*), the chawstick (*Gouania Domingensis*), hardhead (*Phyllanthus epiphyllanthus*), *Erithalis fruticosa* and *Duranta repens*. Among the climbing plants the dream vine (*Echites umbellata*), *Triopteris rigida*, and *Ipomoea sinuata* were common. The coppet was usually quite difficult to penetrate, the trees being mostly small and close together and the underbrush dense.

The third region was the "pine-yard" or pine barrens. This was a comparatively level region occupying the interior of both islands and covered almost exclusively with the Bahaman pine (*Pinus Bahamensis*). Where the ground was a little elevated there were small coppets or islands, as it were, of angiospermous trees; where it was lower and more moist, occasional clumps of palmetto varied the monotony. The Bahaman pines are tall and slender and do not branch until quite near the top. The tallest we saw was about seventy or eighty feet in height and the largest was four feet and nine inches in circumference. They do not grow close together but are usually from ten to twenty feet apart even when

small. A tall brake known as the "maypole" (*Pteridium caudatum*) was very characteristic of the pine belt. It often formed almost impenetrable thickets six or seven feet in height, while at one place on Andros, we found it growing nine feet in height. The "cinecord" (*Acacia choriophylla*) was common in the pines as were also, among the lower plants, *Ascyrum hypericoides*, *Tetrazygia bicolor*, *Linum Bahamense*, *Ernodea littoralis*, and *Vernonia Bahamensis*. The showy sedge (*Dichromena colorata*) and the purple orchid (*Bletia verecunda*) were abundant in the pines and were also occasionally found on the savannas. In many parts of the pine barrens on Andros, there was no underbrush, nothing but a coarse grass called "bed-grass" (a species of *Andropogon*), relieved here and there by the crimson flowers of *Ipomoea repanda*. As one approached the western edge of the pines, the ground became less rocky the trees smaller and smaller, and the palmettos more numerous until one finally emerged on either swash or savannas,

The savannas, constituting a fourth distinct botanical region, were found only on Andros. They were level prairie-like stretches, lying as a rule between the pines and the swash. They were most common in the northwestern part of the island. The ground was not rocky and was covered, for the most part, with a coarse sedge called "saw-grass" (*Cladium Jamaicense*); there were also occasional clumps of palmetto or "brier tree" (*Terminalia spinosa*). This region proved excellent botanizing ground and by far the greater number of the plants found there were met with nowhere else. *Flaveria linearis*, *Polygala Boykinii*, *Eustoma exaltatum*, *Aletris bracteata*, *Gyrostachys tortilis*, and *Gerardia purpurea* were common and in some places *Limodorum tuberosum*, *Buchnera elongata*, and *Samolus ebracteatus*.

The fifth plant region was the "swash." On Andros, this region, as has been said, was very extensive and comprised hundreds of square miles. Here the eroded coral rock, such a prominent feature of the coppet and the pine barrens, was replaced by soft, calcareous mud, in some places more or less hardened, in others very soft. There were numerous ponds and lakes in this region which we were told became connected in wet seasons, making a network of waterways navigable by small boats for many miles. We were there in a comparatively dry season and

the ponds were very shallow, having about three inches of water and eighteen inches of marl.

The scenery was monotonous and desolate. In many places, as far as the eye could reach, the ground seemed perfectly flat and covered with small mangroves, the salt-bush (*Avicennia nitida*), and a low form of button-wood (*Conocarpus erecta*), none more than a few feet in height. The plants were in reality quite scattered and a considerable distance apart, but seen at a distance the effect was that of a smooth expanse of lawn. Here and there a dark line of pines showed on the horizon or one caught the gleam of water, but as a rule only clumps of palmettos or a few shrubs varied the monotony. In some places, especially near the creeks, palmettos were abundant, the most common being the "silver thatch" (*Thrinax Bahamensis*); the "hog cabbage" (*Cyclospathe Northropi*) and the "saw-tooth cabbage" (*Paurotis Androsana*) were occasionally seen; all were of small size. Toward the southern end of the island, the mangroves sometimes attained considerable size and then formed the most prominent feature of the landscape. This desolate, uninhabited region is a paradise for water birds which were found here in great numbers. The flamingoes were the most interesting and these we often saw while on the west side of the island.

I have described the botanical regions in such detail because since we collected in the Bahamas, many of the localities we visited have been destroyed, botanically speaking, by being cleared for the cultivation of sisal. The work was just beginning when we were there, a few sisal plantations having been started on both New Providence and Andros. Several years later, thousands of acres had been cleared and planted with sisal. For this purpose both coppet and pine barrens were available but not the swash. Large companies were formed, a great amount of money was spent in clearing and planting, in making roads, and I believe a small railroad even was built on Andros. It was confidently expected that large fortunes would be made, but after three or four years' trial these hopes proved to be visionary, and I have since heard that many of the plantations have been given up and the land allowed to lapse into its former wild state. It is highly probable, however, that the flora of Andros has suffered more or less change

through the extensive clearing and the probable introduction of cosmopolitan weeds.

## PREVIOUS COLLECTORS

Mark Catesby explored and collected along the southern Atlantic coast from 1731 to 1743 and during that time made a trip to the Bahamas, visiting New Providence and also touching incidentally at Andros. Some of the plants he collected were figured in his Natural History of Carolina, published in 1754. The next record we have of Bahaman plants were the collections sent to Sir William Hooker by Mr. Swainson between 1838 and 1842. These were described by Grisebach and incorporated in his Flora of the British West Indies published in 1864. Less than two hundred species were there recorded from the Bahamas. Between 1880 and 1887, Mr. L. J. K. Brace, of Nassau, sent to Kew through Governor Robinson a large number of Bahaman plants. A list of these has been incorporated in a Provisional List of the Plants of the Bahama Islands, by Gardiner, Brace, and Dolley, which was published by Dr. Dolley in the Proceedings of the Academy of Natural Sciences of Philadelphia in 1889. This list however is not always clear as to which are native and which cultivated species, and in the majority of cases the place of collection is not given. A small collection of plants made by a Mr. Cooper were presumably sent to Dr. Torrey at Columbia University, as they form a part of the Torrey herbarium. With very few exceptions, all the above collections were made on the island of New Providence.

In 1887, a grant was made by the British Association, for the investigation of the Bahaman flora, and the Danish botanist, Baron Eggers, undertook the work. He spent from November 1887, to April 1888, in the islands and brought back 314 species. A few were collected on Fortune Island and Long Island but the great majority were from New Providence. Professor T. H. Herrick, of Johns Hopkins, visited Abaco in 1886 and collected a small number of plants noted in the Johns Hopkins Univ. Circ. 6 : 46. During the winter of 1890–91, Professor Albert S. Hitchcock, of the Missouri Botanical Garden, accompanied a party of naturalists, headed by Dr. J. T. Rothrock, of the University of Pennsylvania, on an

exploring trip through the Bahamas. Eleuthera, Cat Island, Watling's Island, Crooked and Fortune islands, and Inagua were visited as were also the islands of Jamaica and Grand Cayman. The report of the plants collected was published in 1893 by Professor Hitchcock in the Report of the Missouri Botanical Garden. The total number of plants there noted from the Bahamas was 380, and of these two were described as new.

## ANALYSIS OF THE COLLECTION

The collection enumerated in the following pages consists of 542 species (461 exclusive of the cryptogams) to which are to be added six varieties and twenty-one cultivated plants. Two of the collection proved indeterminable on account of insufficient material, while fifteen could only be determined generically for the same reason. The total number of families of flowering plants represented is 93, the number of genera, 304. The families most largely represented are Leguminosae, with 45 species; Compositae with 34; Rubiaceae with 24, and Euphorbiaceae with 21, while Orchidaceae, Convolvulaceae and Verbenaceae come next. The genus most largely represented is *Ipomoea*, of which we collected thirteen species; eight species of *Cassia* were found, and six species each of *Euphorbia*, *Coccolobis*, and *Tillandsia*, while *Passiflora* and *Eupatorium* each have five species. As will be noticed there is a very large proportion of genera to the number of species, in the majority of cases a genus being represented by but a single species.

Of the plants collected a new *Chara* was described and published by Dr. T. F. Allen, an *Anastraphia* by Mr. J. M. Greenman, of Cambridge, a *Jacquinia*, by Professor Mez and new species of *Caesalpinia*, *Phyllanthus*, *Reynosia*, and *Casearia* by Professor I. Urban, of Berlin in Symbolae Antillanae. In addition new species of *Hymenocallis*, *Aletris*, *Vanilla*, *Phoradendron*, *Pithecolobium*, *Cassia*, *Linum*, *Erythroxylon*, *Crossopetalum*, *Rhamnidium*, *Helicteres*, *Xylosma*, *Terminalia*, *Heliotropium*, *Tecoma*, *Catesbaea*, *Myrstiphyllum*, *Anguria*, *Metastelma*, and *Eupatorium* are described in this paper, as well as two new genera of palms, *Paurotis* and *Cyclospathe*. The type specimens are in the herbarium of Columbia University. Sets are also at Kew, the Royal Botanical Garden at Berlin, the Gray herbarium, and Geneva. As far as I can discover,

the following genera, also, have never before been reported from the Bahamas: *Coccothrinax*, *Inodes*, *Aletris*, *Vanilla*, *Broughtonia*, *Polystachya*, *Cranichis*, *Limodorum*, *Hypoxis*, *Pedilanthus*, *Maba*, *Mitreola*, *Voyria*, *Trianosperma*, and *Aster*.

My sincere thanks are due those who have assisted me in the preparation of this report, especially to the following specialists who kindly determined the cryptogams: Mr. Frank S. Collins, of Malden, Mass., the algae; Dr. Albert Schneider the lichens; Professor Lucien M. Underwood the fungi; Mrs. Elizabeth G. Britton the mosses, and Professor D. C. Eaton who determined a number of the doubtful ferns in 1890. The report on the palms has been prepared by Mr. O. F. Cook, of the Department of Agriculture at Washington, to whom I here wish to express my obligations. Dr. N. L. Britton and Mr. George V. Nash kindly named the grasses, and Dr. Britton the sedges. I am also greatly indebted to Dr. Britton for advice on many points and for his kindness in comparing and identifying a number of our plants at Kew in 1891, also to him and to Dr. John K. Small for revising the nomenclature in many instances, and to Professor Underwood for revising the names of the ferns and other kindly assistance. A number of doubtful specimens were compared by me at Cambridge in 1897 and I take this opportunity of thanking Dr. B. L. Robinson and his assistants for the kindness then shown me and for a number of determinations they were good enough to make for me the following year. I also wish to acknowledge gratefully several determinations made for me by the authorities at Kew in 1897.

The new species have been most successfully drawn by Miss Mary V. Thayer, of Holbrook, Mass., to whom I wish to express my thanks for her careful work.*

* The long period that has elapsed since the collection of these plants, and the publication of this report may call for a word of explanation. My husband was work-

# LIST OF PLANTS

## THALLOPHYTA

### MARINE ALGAE*

## CHLOROPHYCEAE

### CLADOPHORACEAE

CHAETOMORPHA sp. ? Lake Waterloo, near Nassau, Jan. (209).

CLADOPHORA sp. ? Ft. Montague, Nassua, Jan. (163).

### CAULERPACEAE

CAULERPA CLAVIFERA Ag. Quarantine Cay, Nassau, Jan. (182).

CAULERPA ERICIFOLIA Ag. Lake Waterloo, Nassau, Feb. (301).

* CAULERPA PLUMARIS Ag. Lake Waterloo, Nassau, Jan. (208).

### CODIACEAE

PENICILLUS CAPITATUS Lamour. Quarantine, Nassau, Jan. (187).

† RHIPOCEPHALUS PHOENIX J. Ag. Quarantine Cay, Nassua, Jan. (190).

† UDOTEA CONGLUTINATA Lamour. Salt Cay, Nassau, Jan. (233).

UDOTEA FLABELLATA Lamour. Quarantine Cay, Nassau, (183, 300).

† HALIMEDA TRIDENS Lamour. Salt Cay, Nassau. Quarantine Cay, Nassua, Jan. (191).

* HALIMEDA TUNA Lamour. Salt Cay, Nassau, Jan. (232).

### VALONIACEAE

* VALONIA AEGROPHILA Ag. ? Lake Waterloo, Nassau, Jan. (210).

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ing up the zoölogical collections and I the plants, when his sudden death occurred in June 1891. Since then ill-health has year after year prevented any continuous work and the frequent lapses of time have made much revision necessary. My husband greatly assisted me in the beginning of the work and my sole motive in continuing it alone was because of his interest in my doing it.

* Determined by Mr. Frank S. Collins, of Malden, Mass., 1891.

† DICTYOSPHAERIA FAVULOSA Decne. Quarantine Cay, Nassau (188).

MICRODICTYON AGARDHIANUM Decne. Salt Cay, Nassau, Feb. (273).

### DASYCLADACEAE

† DASYCLADUS OCCIDENTALIS Harv. Ft. Montague, Nassau Jan. (161).

† ACETABULARIA CRENULATA Lamour. Lake Waterloo, Nassau, Jan. (211).

CYMOPOLIA BARBATA Lamour. Silver Cay, Nassau, Jan. (156).

CYMOPOLIA MEXICANA J. Ag. Silver Cay, Nassau, Jan. (155).

BLODGETTIA CONFERVOIDES Harv. Doubtful position and value. Quarantine (192).

## PHAEOPHYCEAE

### FUCACEAE

CYSTOSEIRA MYRICA Kütz. Nicol's Town, Andros, March (337).

* TURBINARIA VULGARIS Ag. Quarantine Cay, Nassau, Jan. (185).

SARGASSUM FILIPENDULA LAXA J. Ag. Ft. Montague, Jan. (158).

SARGASSUM sp. Salt Cay, Nassau, Feb. (268–275).

### DICTYOTACEAE

DICTYOTA DICHOTOMA Lamour. Quarantine, Jan. (177).

* DICTYOTA FASCIOLA Lamour. Salt Cay, Feb. (274).

* PADINA PAVONIA Gaillon. Silver Cay, Nassau, Feb. (154).

ZONARIA LOBATA Ag. Salt Cay, N. P., Jan. (259); Goat Cay, Andros, June (632).

## RHODOPHYCEAE

### HELMINTHOCLADIACEAE

LIAGORA CHEYNEANA Harv. Salt City, Nassau, Feb. (272).

LIAGORA ELONGATA Zan. Silver City, Nassau, Jan. (153).

† LIAGORA VALIDA Harv. Goat Cay, Andros, June (748).

### CHAETANGIACEAE

* GALAXAURA LAPIDESCENS Lamour. Salt City, Nassau, Feb. (260, 271).

RHODOMELACEAE

LAURENCIA PANICULATA J. Ag. Quarantine, Nassau, Jan. (179). Some specimens near *L. obtusa* Lamour.

* DIGENIA SIMPLEX Ag. Quarantine Cay, Nassau, Jan. (180).

† POLYSIPHONIA HAVANENSIS Mont. Ft. Montague, Jan. (160, 181).

† POLYSIPHONIA PECTEN-VENERIS Harv. Ft. Montague, Nassau, Jan. (159).

POLYSIPHONIA sp.? Goat Cay, Andros, June (749).

† DASYA GIBBESII Harv. Ft. Montague, Nassau, Jan. (162).

CERAMIACEAE

* CENTROCERAS CLAVULATUM Mont. Quarantine Cay, Nassau, Feb. (302).

CORALLINACEAE

LITHOTHAMNION? Quarantine Cay, Nassau, Feb. (304, 305).

* JANIA RUBENS Lamour. Quarantine Cay, Nassau, Jan. (178).

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*Notes on Distribution.* — The species of marine algae marked * are generally distributed in warm waters. The species marked † are limited to the West Indian and Florida region. "*Liagora elongata* and *Cystoseira myrica* are characteristic Red Sea plants; *Liagora Cheyneana* is an Australian species. *Liagora elongata* and *Cymopolia Mexicana* are, I think, new to the West Indian region, although it is now considered rather doubtful whether the last-named species is distinct from *C. barbata*."

**CHARACEAE**

CHARA DEPAUPERATA T. F. Allen. Described in Bull. Torrey Club, **21**: 267. 1894. Fresh Water Pond, Hog Island, N. P., Feb. (258).

CHARA sp.? In brackish water. Stafford Creek, Andros, May (547).

**LICHENES***

CLADONIA GRACILIS (L.) Nyl.? (Not mature.) Nicol's Town, Andros (346).

CLADONIA FLOERKEANA Fr. Nicol's Town, Andros (347).

* Determined by Dr. Albert Schneider at Columbia University.

CLADONIA sp.? On palmetto. Red Bays, Andros, April (484).

LEPTOGIUM PULCHELLUM (Ach.) Nyl. Nicol's Town (444).

LEPTOGIUM TREMELOIDES (L.) Fr. Nicol's Town (382).

RAMALINA PUSILLA (Prev.) Tuck. Nassau (755).

With the exception of 484, all are quite common and widely distributed species.

**FUNGI***

SCHIZOPHYLLUM ALNEUM (L.) Schröt. Nicol's Town, March (351).

CLATHRELLA CRISPA (Turpin) E. Fischer. Andros (798).

DIPLOCYSTIS WRIGHTII B. & C. Andros (777). Also reported from Inagua by Hitchcock.

TRAMETES CINNABARINA (Jacq.) Fr. Andros (793).

AURICULARIA AURICULA (L.) Schröt. Andros (794).

FOMES IGNIARIUS (L.) Fr. Andros (797).

## BRYOPHYTA†

TORTULA AGRARIA (Sw.) Hedw. Nassau and Nicol's Town (34, 341, 168).

HYOPHILA BARBULA (Schwaegr.) Hampe. Nassau (169, 170).

MACROMITRIUM INSULARUM Mitt. Nicol's Town, Andros, March (342, 345).

SEMATOPHYLLUM SERICIFOLIUM Mitt. Nicol's Town (343, 530).

SYRRHOPODON FLAVESCENS Mueller. Nicol's Town, March (344).

OCTOBLEPHARUM ALBIDUM Hedw. New Providence, Feb., Nicol's Town (348, 746).

## PTERIDOPHYTA

### SCHIZAEACEAE

ORNITHOPTERIS ADIANTIFOLIA (L.) Bernh. Common and variable; abundant in the pines. Nassau, Jan.; Nicol's Town, March (12, 15, 83, 300).

*ORNITHOPTERIS CICUTARIA (Kunze) Underw. (*Anemia cicutaria* Kunze, Linnaea, 9: 22. 1835.) On rocks, not common. Nassau, Jan. (165).

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* Determined by Professor Lucien M. Underwood.

† Determined by Mrs. Elizabeth G. Britton at Kew.

POLYPODIACEAE

*DRYOPTERIS PATENS (Sw.) Kuntze. In banana holes and rocks along roadsides; common and variable. Nassau, Jan.; Nicol's Town and Red Bays, April (173, 240, 441, 469).

*DRYOPTERIS ASPLENIOIDES (Baker) Kuntze. Clefts of rocks, uncommon. Indusium small, pinnae narrow and distant. Conch Sound, March (416).

TECTARIA TRIFOLIATA (L.) Cav. On sides of banana holes; not common. Conch Sound, May (562).

DAVALLIA CLAVATA Sw. Common. Nassau, Jan. (133). Same as Wright 961.

*ASPLENIUM DENTATUM L. Pinnae large and close together. Caves near Nassau, Feb. (286).

BLECHNUM SERRULATUM Rich. Caves near Nassau, Feb. (285). Same as Fendler 133.

ADIANTUM TENERUM Sw. In banana holes. Near Nassau, Feb.; Red Bays, April (288, 489).

PTERIDIUM CAUDATUM (L.) Maxon. "May-pole." Very common on both New Providence and Andros; makes dense thickets the pines, six to eight feet high (313).

PTERIS LONGIFOLIA L. Common on walls. Nassau, Jan. (18, 94).

VITTARIA LINEATA (L.) Sm. On palmettos, not common. Red Bays, April (472).

CHEILOGRAMMA LANCEOLATUM (L.) Blume. Leaves 10–14 inches in length. On trees, not common. Nicol's Town, March (356).

ACROSTICHUM AUREUM L. "Wild ginger." In low ground, not common. Conch Sound, May; Deep Creek, June (408, 714). 714 was growing in a banana hole; the leaves were shorter than in 408, fertile almost to the base and the rachis was deeply sulcate.

PHLEBODIUM AUREUM (L.)R.Br. Common on palmettos. Hog Island, N. P., Feb.; Purser Point, Andros, June (249, 625, 665, 720). No. 665 is a sport with leaves very glaucous and pinnae deeply crenate.

POLYPODIUM POLYPODIOIDES (L.) A. S. Hitch. On trees, not uncommon. Nicol's Town, April; Conch Sound, May (442).

CAMPYLONEURON PHYLLITIDIS (L.) Presl. In banana holes, not uncommon. Conch Sound, May (566).

POLYPODIUM SQUAMATUM L. On trees, Conch Sound, March. Determined by Professor Eaton (406).

* PHYMATODES SWARTZII (Baker) Underw. In banana holes, rare. Leaves difform, there being a number of short and broad sterile leaves. Conch Sound, May (581). Same as Wright 799.

GONIOPTERIS REPTANS (Sw.) Presl. In banana holes. Conch Sound, May. Determined by Prof. D. C. Eaton (583).

GONIOPTERIS REPTANS CORDATA. In banana holes. Conch Sound, May. Determined by Professor D. C. Eaton (576).

### PSILOTACEAE

PSILOTUM NUDUM (L.) Griseb. In hollows in trunks of trees, not common. Cocoanut Pt., Andros, April; Fresh Creek, June (515).

## SPERMATOPHYTA

### CYCADACEAE

ZAMIA sp. "Bay rush." Common in the pines in certain localities. Leaves 15–25 cm. in length, leaflets but ten pairs, seldom opposite, thick, with revolute margins, 3.5–5 cm. long, 6–9 mm. broad. Seems to be nearest *Z. pumila* L.; resembles Wright 3193. Stafford Creek, Andros, May (550).

### CONIFERAE

PINUS BAHAMENSIS Griseb. Covers large tracts in the interior of both New Providence and Andros. N. P., Jan.; Nicol's Town, April; Conch Sound, May (84, 440).

JUNIPERUS BARBADENSIS L. Not common. Southwest Beach, N. P., Feb.; Nicol's Town, Fresh Creek, June (321, 355).

### TYPHACEAE

TYPHA DOMINGENSIS Pers. Nicol's Town, March (353).

### NAIADACEAE

RUPPIA MARITIMA L. Stafford Creek, Andros, May. Determined by Rev. Thomas Morong (536).

### GRAMINEAE †

ANDROPOGON sp. "Bed grass." Purser Pt., Andros, common (659). Specimens not in flower.

* Species marked with a star were verified by Professor D. C. Eaton, 1891.

† Determined by Dr. Nathaniel L. Britton and Mr. George V. Nash.

PASPALUM FIMBRIATUM H.B.K. Nassau, Jan. (118).

PANICUM DIVARICATUM L.? (Not in flower.) Deep Creek, Andros, July (732).

PANICUM PROLIFERUM Lam. Fresh Creek, June (620).

PANICUM sp. Hog Island, Nassau, Feb. (248).

CENCHRUS TRIBULOIDES L. "Devil grass." Nassau, Jan.; Deep Creek, July (148, 719).

SPOROBOLUS VIRGINICUS Kunth. Deep Creek, July. On sandy shores (728).

STENOTAPHRUM AMERICANUM Schrank. Common along shore. Nicol's Town, April (520).

CHLORIS SWARTZIANA Doell. "Finger grass." Nicol's Town, April (521).

CHAETOCHLOA GLAUCA (L.) Scribn. Fresh Creek, June (618).

ERAGROSTIS CILIARIS (L.) Link. Nassau, Jan. (167).

UNIOLA PANICULATA L. "Bay rush." Quarantine Cay, Nassau, Feb. (314).

PHRAGMITES or ARUNDO? Only glumes remaining. Near Southwest Beach, N. P., Feb. (315).

DISTICHLIS sp. "Rabbit grass." Big Cabbage Creek, June. Common on edge of swash. Red Bays (485).

ARTHROSTYLIDIUM CAPILLIFOLIUM Griseb.? "Old man's beard." Not in flower. Nassau; common. climbing over shrubs and bushes. Branches leafy, leaves fascicled, wiry, filiform (93).

### CYPERACEAE *

CYPERUS BRUNNEUS Sw. Common. Hog Island, N. P.; Nicol's Town, April (435).

CYPERUS FERAX Rich. Nassau, Feb. (287).

CYPERUS OCHRACEUS Vahl. Nassau, Jan. (144).

ELEOCHARIS CAMPTOTRICHUS SCHWEINITZII C. B. Clarke. Conch Sound, April (745). Determined by C. B. Clarke, Kew, 1891. "Same as the plant collected in Guadeloupe by Bertero, taken as *E. tenuissima* by Boeck., called by me as above; also mixed in Wright, 3367 from Cuba."

ELEOCHARIS CAPITATA (Willd.) R. Br. Fresh-water Pond, Hog Island, Nassau (247).

* Determined by Dr. Nathaniel L. Britton.

ELEOCHARIS OCHREATA Nees. In banana holes in the pines. New Providence (327).

DICHROMENA COLORATA (L.) A. S. Hitchc. Common in the pines, also found in abundance on the savannas at Red Bays, Andros, New Providence, Jan.; Red Bays, April (100, 466).

FIMBRISTYLIS MONOSTACHYA (L.) Hassk. Fresh Creek, Andros June (634).

FIMBRISTYLIS SPADICEA (L.) Vahl. Mastic Pt., Andros, June; Purser Pt., June (596, 667).

RHYNCHOSPORA MICROCARPA Baldw. Red Bays, April (493). Same as Eggers 4308 from Bahama.

RHYNCHOSPORA CYPEROIDES (Sw.) Mart. Nassau, Feb. (288).

CLADIUM JAMAICENSE Crantz. "Saw-grass." Fresh Creek, June (635).

SCLERIA FILIFORMIS Sw. Mastic Pt., Andros, June (603).

## PALMS FROM THE BAHAMAS*

The palms have been neglected so generally in botanical collections that many striking novelties still remain to be secured by those who brave the inconvenience of handling plants so unmanageable by ordinary herbarium methods. The present small series of Bahama palms shows what may be expected in many parts of the tropics, though for the benefit of botanists who may wish to emulate the example of Dr. and Mrs. Northrop it may be permissible to add that when other material is being secured, ripe fruits, or even the naked seeds, are extremely desirable, and may usually be picked up at the base of the tree long after the fruiting season has passed.

The present list recognizes five palms from the Bahamas, though two of these are not named specifically for lack of adequate material. One may be the species reported by Professor Hitchcock as *Thrinax argentea* while our *Thrinax Bahamensis* may correspond to his *T. parviflora*, though numerous species of this group are doubtless to be found in the Bahama archipelago. Grisebach reported only *Sabal umbraculifera*, a name no longer tenable. It has been stated also that the Bahamas have a cabbage palm (*Euterpe*) and a royal palm (*Oreodoxa*), but these names are also

* The families Sabalaceae and Arecaceae were contributed by O. F. Cook.

not available for West Indian palms. Moreover, it is not known that specimens exist from which better identifications could be made.

SABALACEAE

**Thrinax Bahamensis** sp. nov.

Leaves and inflorescence resembling *Coccothrinax jucunda* Sargent (Bot. Gaz. **27**: 89. 1899), but apparently to be associated rather with *Thrinax Keyensis* Sargent (Bot. Gaz. **27**: 86. 1899) in view of the short pedicels, distinctly lobed calyx, broad filaments and short styles.

Petiole 48 cm. long, 15 mm. broad at base, narrowed to 12 mm. near the apex; equally convex on both sides, becoming flat above toward the base; segments of middle of leaf about 53 cm. long, and 32 mm. broad; lateral segments reduced to 30 cm. by 5 mm.; texture thin and brittle; venation also closely similar to *C. jucunda*, but the surface distinctly less pubescent, or the pubescence much more fugacious, as in other species of true *Thrinax:* inflorescence with secondary branches slender, subtended by narrow scarious bracts, 8 to 10 mm. in length; bracts with a distinct midvein and a pencil of hairs at the tip; pedicels of flowers seldom 1 mm. in length, with 6 distinct subtriangular lobes: filaments triangular, often united at base to form a complete cup: stigma truncate or somewhat funnelform, about 0.5 mm. in length.

This species is evidently much smaller in all its parts than *Thrinax Keyensis.* The comparison of its leaves with those of *Coccothrinax jucunda* is based on A. H. Curtis's no. 262 from Big Pine Key, which seems to correspond well with Sargent's description, though there is the possibility that the leaf and fruit were not taken from the same tree.

*Locality.* — Big Cabbage Creek, Andros Island, June. Another specimen (257) from Freshwater Pond, Hog Island, N. P., February, consists of a leaf and an old inflorescence, the latter with the spathes still coated in patches with dense white pubescence.

In comparison with *Thrinax Ponceana* (Bull. Torrey Club, **28**: 536. 1901) from Puerto Rico the leaves of the present species are smaller, with the petioles less flattened and more distinctly ribbed on the upper side near the apex. The transverse or oblique vein-

ules are more numerous and more prominent; also the veinules of the lower surface, which lacks the glaucous or waxy covering distinct in *T. Ponceana*.

COCCOTHRINAX sp.

A single leaf with the form and veination of *C. Garberi* (Chapman) but somewhat less densely pubescent. Locality: New Providence, Nassau, February 1890 (no. 284).

Mr. Lyster H. Dewey, of the U. S. Department of Agriculture, recently brought back from New Providence Island a leaf probably belong to a *Coccothrinax* and popularly called "silver thatch." The leaves are commonly used for weaving into hats and baskets. The trunk seldom, if ever, exceeds about 2.5 m., and is about 15 cm. thick. A photograph secured by Mr. Dewey shows that the surface is largely free from leaf-bases, and fairly smooth, the leaf-scars being but slightly impressed. The diameter seems to be rather uneven, with a tendency to become somewhat thicker in the middle.

**Paurotis** gen. nov.

A small, slender palm with spiny petioles like *Copernicia*, but with only the primary branches of the slender inflorescence subtended by spathes.

*Paurotis* is probably more nearly related to *Serenoa* than to *Copernicia*, but differs in the larger size, the erect trunk, the stronger ligule, the absence of the ligule-like inferior scales, the presence of a rudimentary midrib, and in the more deeply divided segments. Inflorescence much more slender throughout than in *Serenoa;* flowers much smaller, with free sepals and short, valvate petals.

The long, naked and apically scarious and bilabiate spathes are strikingly different from those of *Copernicia*. The inflorescence is much longer and more slender than that of *Serenoa*, but in other respects has greater resemblance than to that of *Copernicia*. The leaves, on the other hand, are more like *Copernicia*, though the presence of a true midrib, even if very small, with one or two segments inserted somewhat above the base may be taken as a further sign of affinity with *Serenoa*.

The present genus will probably accommodate the palm from Puerto Rico (*Sintenis, 6512*) referred by Professor Drude to

*Copernicia*, but having no spathes on the branches. Grisebach and Wendland described from Cuba, *Copernicia Wrightii*, which may also belong to *Paurotis*.

Hitherto *Copernicia* has been the only known West Indian genus of fan-palms with spiny petioles. The type of *Copernicia* is *C. cerifera* (Arruda) from Brazil, but the Cuban species of the genus seem to resemble *Paurotis* even less than the Brazilian, since they have the inflorescence more robust and compact and the spathes more strongly developed. The species listed by the *Index Kewensis* as *Copernicia maritima* (*Corypha maritima* H.B.K.) and *Copernicia pumos* (*Corypha pumos* H.B.K.) have smooth petioles according to the original descriptions, and should have been transfered to *Thrinax* rather than to *Copernicia*. Although treated as a synonym of *Copernicia* in the *Index Kewensis* the generic name *Cryosophila* Blume had priority of publication, as shown by the fact that it is cited by Martius in connection with the orginal description of *Copernicia*. It seems probable, however, that *Crysophila* is distinct from *Copernicia* as indicated by Drude. Its type, *C. nana* (H.B.K.), came from the region of Acapulco, Mexico. The petiole is unarmed and other characters are quite at variance with those of *Paurotis*.

**Paurotis Androsana** sp. nov.

Trunk 3 to 4 m. high, very slender, 5 to 6.5 cm. in diameter, rough with irregular scale-like leaf-bases: leaves tufted, flat, orbicular; petioles 52 cm. long, 15 mm. thick at base, 10 to 12 mm. at apex, not including the spines, 5 mm. thick at base, 3 mm. at apex; upper face moderately concave, subcarinate in the middle distad; lower face strongly convex in the middle, concave on each side; upper surface with fine longitudinal or oblique impressions, doubtless from the next leaf; lower surface nearly smooth, very finely grooved longitudinally; both surfaces covered with a thin layer of waxy scales; toward the margins are small scattering brownish longitudinal scars, more numerous on the upper side; occasionally there arises from such a scar a narrow scarious ribbon 2 mm. or less in length; these evidently correspond to the peltate scales of the leaf-bases and petioles of *Inodes;* margins of petioles thickened, smooth, corneous, in color pinkish-brown (vinaceous-cinnamon, Ridgway) at base, and dark brown distad; teeth somewhat irregularly placed, usually about 1 cm. apart, but sometimes 2 cm. and some-

times close together or with two points; points commonly curved forward, sometimes straight or curved backward; length about 3–5 mm.; size decreasing toward the apex of the petiole, but occasional teeth are mere rudiments: ligule very broadly subtriangular after losing a rather broad, thin, subscarious margin; lateral angles of the ligule coalescing with the margins of the lateral segments as in *Thrinax* and related genera; each side of this terminal widening of the petiole bears a strongly curved marginal tooth.

Apex of petiole on the under side, broadly triangular, about 5 mm. long. The oblique edges which subtend the insertion of the segments do not, however, meet in the middle; the middle rib is slightly thicker than the others and has one or two segments inserted on each side beyond the apex of the triangle, so that *Paurotis* may be said to have passed the stage of *Thrinax* and to have a true midrib.

Leaves about 52 cm. long, composed of about 36 segments; middle segments longest, the lateral shortened nearly by half. Segments united for about 20 cm. in the middle of the leaf, but only for 1 to 3 cm. at the sides. The segments are split 20 cm. or less from the tips. The margins of the notch are somewhat thickened, but there is no fiber like that of *Inodes*. The edges of the ribs both above and below are nearly square, and bear along the angles rows of irregularly placed brown scars like those of the margins of the petiole. Both surfaces of the leaf have a thin film of wax. There are from 8 to 11 longitudinal veinlets larger than the others and 1 mm. or more apart; between these are similar numbers of finer equal veinlets, the middle one sometimes slightly larger; oblique veinlets distinct, but very fine, not close.

Inflorescence 80–90 cm. long, the main axis bearing from 9 to 10 tubular spathes. Base of inflorescence flattened and the lower spathe with compressed, wing-like margins. The spathes are open only at the bilabiate apex.

*Locality.*—"Loggerhead Creek, Andros, April 22. Not common. Said by negroes to be more common on Eleuthera and islands south." The specimen (509) consists of two leaves and two inflorescences with young flowers.

INODES sp.

The genus *Inodes* is represented by a single inflorescence. The calyx and corolla are longer than in *I. Palmetto* (Loddiges), the calyx more deeply lobed and the margins of the petals more distinctly papillate-denticulate. The two unequal triangular scales which subtend the flowers are also somewhat larger. These facts indicate specific distinctness, but in the abscence of other data the application of a name may be postponed.

*Locality.*—"In swamps along road near Nassau, February 5." The leaf which bears the same number (284) is here referred to *Coccothrinax.*

A large-leaved fan palm from which material for weaving hats and baskets is obtained was noticed by Mr. Lyster H. Dewey growing in swampy places on New Providence Island. It attains a height of about 5 meters and is possibly different from the palm reported from Cat Island by Prof. A. S. Hitchcock (Report Mo. Bot. Gar. **4**: 138. 1893) as *Sabal umbraculifera.* This occurs in dry situations, attains a height of about 8 meters, and has an inflorescence 1.2 m. long. The berries are 12 mm. in diameter, the seed concave at base and the embryo lateral. As already explained elsewhere (Bull. Torrey Club, **28**: 531. 1891) the name *umbraculifera* was not available for transfer from *Corypha* to any American palm, and the application of the next available name *Inodes Blackburniana* (Glazebrook) has not yet been fixed.

ARECACEAE

**Cyclospatheae,** new tribe

To accommodate the following genus *Cyclospathe* and *Pseudophoenix* Wendland. The association of the latter with *Morenia, Gaussia,* and *Synechanthus* as proposed by Professor Drude, seems to have little warrant.

The Moreniaceae are monoecious palms with numerous cylindrical partial spathes and sessile flowers arranged in rows. The Cyclospatheae are apparently dioecious palms with a single complete spathe and pedicellate flowers, without orderly arrangement. The Cyclospatheae may also be recognized at once by their strongly conduplicate leaf-segments, a feature in which they are especially divergent from *Chamaedorea* and the related genera,

which have the bases of the segments more open than in most of the pinnate-leaved palms.

### **Cyclospathe** gen. nov.

A small palm obviously allied to *Pseudophoenix* Wendland, but distinct in having the trunk short and with short internodes, the inflorescence infrafoliar, and the calyx deeply lobed; also in the possession of a curious, short, collar-like spathe completely encircling the main axis of the spadix near the middle of its base.

The leaf segments are strongly folded together like those of *Pseudophoenix*, but the lower margin is not incurved to bring it against the upper as in *Pseudophoenix*. The "dark conspicuous gland-like excrescences" described by Sargent (Silva, **10**: 33) on the sides of the rachis at the base of the pinnae are evidently much smaller in *Cyclospathe*, and are mostly confined to the angle of insertion of the upper margin of the pinnae.

Further differences between *Cyclospathe* and *Pseudophoenix* are discussed in connection with the following description of the type species:

### **Cyclospathe Northropi** sp. nov.

Trunk less than 3 m. in height, about 22 cm. in diameter, slightly bulging in the center; leaf-scars distinct, about 2.5 cm. apart; leaf-bases very glaucous, also the rachis; rachis distally subtriangular in section, the leaf-bases completely crossing the lateral faces and even prominent above the narrow crest; upper and lower margins of the pinnae inserted on the same plane at the lateral angles of the rachis; segments are not so strongly plicate as in *Pseudophoenix*, the two edges meeting the rachis about 5 mm. apart, and not thickened and incurved as in the heavier and larger leaf of *Pseudophoenix*.

The specimens studied have about 20 of the apical pinnae on each side; lower pinnae about 47 cm. long by 23 mm. broad; apical pinnae gradually reduced to 27 cm. by 10 mm. and smaller, the terminal divisions not completely separated. The distal pinnae are farther apart than the proximal.

In *Pseudophoenix* pinnae 43 cm. long have a width of 33 mm. The texture of the pinnae of *Cyclospathe* is also much thinner and more fragile than in *Pseudophoenix*, and the decurved and thick-

ened anterior margin is broader. The upper surface shows several rather prominent veinules not regularly spaced; below, the veinules are very numerous, close and equal. The upper surface is smooth and shining, the lower dull and uniform, the space between the veinules being minutely roughened. In *Pseudophoenix* both surfaces appear more distinctly glaucous.

The spadix at the flowering stage is about 35 cm. long, and about 12 mm. broad at the flattened base. There are nearly 20 primary branches decreasing in size from the lowest, which is 11 cm. long and 3 mm. thick at base. The branches are twice or thrice subdivided, the ultimate divisions being about 15 mm. long and bearing solitary flowers at intervals of about 1 mm., but without regularity of arrangement apparent in the dried specimen. Each branch and flower is subtended by a triangular pointed bract, those of the primary branches being 5 to 8 mm. long, strongly acuminate with a very broad base which at the lowest fork is continued half way round the stem. A similar growth is probably referred to by Sargent as a "thickened ear-like body" on the upper side of the base of the branches of the inflorescence of *Pseudophoenix.*

The most curious peculiarity of *Cyclospathe* is a further extension of such a bract or rudimentary spathe to form a complete frill-like band or collar about the middle of the basal stalk of the inflorescence. This structure is about 5 mm. wide, of a light brown color; texture firm, but thin and rather brittle in the dried state.

Flowers (perhaps immature) about 2 mm. long. Calyx tubular forming a pedicel-like base 1 mm. long; at apex splitting into three triangular slightly imbricate lobes. Corolla thick and fleshy, the petals valvate. No stamens or staminodia were made out, and the indications are that *Cyclospathe* is dioecious. Sargent characterizes *Pseudophoenix* as monoecious, but apparently without reason, as he says afterward "flowers unknown" and describes only the persistent "staminodia" of the ripe fruit.

*Locality.*—Andros Island. The leaves (508) were collected on Loggerhead Creek in April, 1890, the inflorescence (671) on "Big Cabbage Creek, west side" in June. The local name, "hog cabbage palm," appears with both labels and increases the

probability that the specimens were properly associated. In the event of doubt on this point the inflorescence should be treated as the type.

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COCOS NUCIFERA L. Common in cultivation.

BROMELIACEAE

TILLANDSIA BALBISIANA R. & S. "Wild pine." Common and variable. Red Bays and Conch Sound, April; Lisbon Creek, June (491, 528).

TILLANDSIA BULBOSA Hook. "Wild onion." On mangroves in the swash. Purser Pt., June. Not common (654).

TILLANDSIA FASCICULATA Swartz. "Dog-drink-water." Common. Nicol's Town, Red Bays, April (439).

TILLANDSIA FLEXUOSA Sw. Nicol's Town, March. Like Blodgett's specimen from Key West; not like Wr. 3271 (369).

TILLANDSIA RECURVATA L. Not common. Fresh Creek, Kemp Sound, Andros, June (617).

TILLANDSIA UTRICULATA L. More than 1.5 meters in height. Flowers whitish. Larger than any specimens examined. Fresh Creek, June (612).

COMMELINACEAE

COMMELINA NUDIFLORA L. Nassau, Jan. (7).

RHOEA DISCOLOR (L'Her.) Hance. (*Tradescantia discolor* L'Her.) Nassau, Jan.; Conch Sound, April (26).

LILIACEAE

**Aletris bracteata** sp. nov.

Roots numerous, fibrous: basal leaves numerous, spreading, grayish-green, lanceolate or linear-lanceolate, apex acuminate, rigid, narrowed at the base, 6–10 cm. long, 6–10 mm. wide: scape 5–6 dm. in height, bearing small, scattered bract-like leaves: raceme erect, many-flowered; pedicels about 1 mm. in length; bracts subulate, 4–6 mm. in length, almost equalling the corolla: perianth tubular-oblong, sometimes slightly contracted below the lobes, white, 6–8 mm. long, about 3 mm. wide, slightly roughish on the outside: lobes six, oblong-lanceolate, about one fourth as long as the tube: stamens included, oblong-lanceolate, apiculate at the apex, longer than the filaments: pistil included: ovary adherent to the perianth for the lower half, style flattened and broad at

the base, slightly three-cleft above: stigmas three: ovules numerous: fruit not seen (463).

Common on the savannas near Red Bays, Andros, April.

Closely related to *A. farinosa* L., but differs in the grayish-green longer and narrower leaves, with more rigid apex, the longer bracts and the broader flattened style.

PLATE I. *Aletris bracteata.* Entire plant $\times \frac{2}{3}$; *p*, interior of perianth; *e*, stamen; *r*, pistil.

SMILACACEAE

SMILAX AURICULATA Walt. New Providence, March; Conch Sound, April, Purser Pt., June. Common. Peduncles longer than pedicels (339, 527).

SMILAX HAVANENSIS Jacq. "Saw-brier." Nassau, Jan.; Purser Pt., Deep Creek, June.

Specimens from Nassau and Purser Pt. unarmed; Deep Creek specimens have prickles on midrib of many of the leaves as well as on margin (59, 663).

SMILAX sp.? Unarmed or with very few prickles: branchlets angular: leaves mostly broadest at the apex, obovate or oval, 4–5 cm. long, 3–4 cm. wide, thickish, smooth, apex retuse, mucronate, base acute, margin entire, veins prominulous on both sides; tendrils usually inserted a little below the middle of the petiole: staminate flowers, peduncles longer than the petioles: flower-buds globose: petals elliptical, blunt, 3–4 mm.: anthers oblong. Pistillate flowers not seen. Collected on border of swash at Purser Pt., Andros, June (664).

AMARYLLIDACEAE

AGAVE RIGIDA Mill. "Bamboo." On savannas at Red Bays, April. Not common. Flowers bright yellow. Determined by Mr. J. G. Baker, at Kew, 1897.

AGAVE RIGIDA SISALANA Engelm. "Sisal." Cultivated and escaped. Nassau, Jan. (164).

FURCRAEA CUBENSIS Haw. Specimens imperfect. Nassau, Jan. (203).

**Hymenocallis arenicola** sp. nov.

Bulb large: leaves erect-spreading, fleshy, smooth, dark-green, lance-oblong, 4–5.5 dm. in length, 4–5.5 cm. wide, rounded

at the apex and narrowing at the base to 2.5–3.5 cm.: scape almost equalling the leaves; bracts large, scarious, ovate or lanceolate, 3–6 cm. long, 1–2.5 cm. wide: flowers seven to thirteen in a sessile umbel, white, fragment; tube filiform, white, 5–7 cm. long, shorter than the lobes; divisions of the perianth 8–11 cm., narrowly linear, recurved; crown infundibular, 3–4 cm. in length, less than half as long as the stamens, teeth prolonged into the filaments: anthers linear, 1.5 cm. long, attached below the middle: ovary ovate, three-celled, about 2 cm. long: style filiform, longer than the stamens, about equalling the lobes of the perianth: stigma small, capitate.

Common on sandy beaches on the eastern side of Andros. Collected at Nicol's Town, April; Fresh Creek and Deep Creek, June. Most nearly related to *H. Caribaea* Herb. (519).

PLATE 2. *Hymenocallis arenicola*, inflorescence and leaf × ¾.

HYPOXIS JUNCEA Smith. On border of swash. Red Bays, April, May. Not common (476). The same as Wright 3745, except that it is smaller and more delicate.

### DIOSCOREACEAE

RAJANIA HASTATA L. Common on both islands. Nassau, Jan.; Deep Creek, June. Leaves very slender, 1 cm. in width, or less above the base, otherwise like Wright, Cuba, 1712 (203).

### ORCHIDACEAE

BLETIA VERECUNDA R. Br. Common in the pines on both islands and on the border of the swash on west side of Andros. Nassau, Jan.; Red Bays, March. There seems to be no distinction between this species and *B. purpurea* DC., reported as endemic in the Bahamas (91). Same as 365 Plant. Guat., J. Donnell Smith.

EPIDENDRUM FUCATUM Lindl. "Wild Indian." Common in the coppet. Conch Sound, May; Mastic Point, June; Mars Bay, July (584, 711). Same as Wright 3329.

EPIDENDRUM NOCTURNUM L. Conch Sound, March. In fruit only (414).

EPIDENDRUM ODORATISSMUM Lindl. Growing in sandy soil, near the shore, occasionally on trees near ground, in that case being smaller; flowers very fragrant having an odor like birch.

Collected at Calabash Cay, near Stafford Creek, Andros, June (606).

EPIDENDRUM PHOENICEUM Lindl. "Wild Indian." Not uncommon in the coppet. Fresh Creek, June (609). Differs from Rugel 814, in having the bracts much shorter, 5–7 mm. long, more obtuse, and the lip more strongly crispate.

EPIDENDRUM sp.? Single specimen from Stafford Creek, June. Aërial, tubers small, one-phyllous, leaf 5–6 cm. in length, linear-oblong, crenulate: scape 3 dm. in height, few-flowered: flowers white, 2 cm. long, divisions of perigone narrow (674).

EPIDENDRUM? In fruit only. Aërial, tuber two-leaved, leaves 3 dm. in length, 5 mm. in width: capsule oblong, 2 cm. long, 8–10 mm. wide. In the pines, Lisbon Creek, Andros, June (679).

BROUGHTONIA LILACINA Henfr. (*Laeliopsis Domingensis* Lindl.) Common in the coppet. Cocoanut Point, April; Fresh Creek, Lisbon Creek, June (437, 448, 546).

POLYSTACHYA LUTEOLA Hook. On trees, in coppet. Conch Sound, April (525).

POLYSTACHYA sp.? Close to *P. lutcola* but much smaller; leaves 12–14 cm. long, 1 cm. broad: flowers 5–7 mm. long, lip three-lobed, callous at base, column very short. Conch Sound, March and May (407).

GOVENIA UTRICULATA Lindl. In fruit only. Conch Sound, March. Determined by Mr. J. M. Greenman, at Cambridge (418).

ONCIDIUM SYLVESTRE Lindl.? Not uncommon under the pines. Conch Sound and London Creek, May. It has the habit of *O. sylvestre* but the white pink-spotted flowers are smaller and leaves shorter; lip 8–10 mm. in width: leaves 8–12 cm. long (543).

ONCIDIUM VARIEGATUM Sw. On trees, Conch Sound, May. Leaves longer and narrower (3–4 mm. in width), than in Wr. 668 and Eggers 1796 from St. Domingo (587).

ONCIDIUM sp. On trees, rare. Fresh Creek, June. Near *O. variegatum* Sw. Flowers deeply spotted, divisions of perigone narrower, 2–4 mm. wide, abruptly pointed: leaves 6–8 mm. wide (647).

ONCIDIUM sp.? near *O. sphacelatum.* Lindl. Single specimen

from Mastic Point, June; terrestrial, 1.5 m. in height; scape lateral; greenish-yellow flowers panicled; leaves equitant, recurved, rosulate from flattened tubers (602). No. 750 collected at Mars Bay, Andros, in July is probably a smaller specimen of the same species and no. 405 from Conch Sound, an *Oncidium* in fruit only, may perhaps be referred to the same species.

**Vanilla articulata** sp. nov. "Link-vine," "wormwood"

A tall climber with aërial roots, growing over trees and shrubs, aphyllous; stems jointed, joints fleshy, smooth, subangular, 2–3 dm. in length: flowers in short axillary spikes, 6–12-flowered; bracts broadly ovate or triangular, blunt, 5 mm. in length: flowers about 6 cm. long, fleshy, white with faint pinkish tinge, parts of perigone jointed at the base: sepals erect, spreading, fleshy, oblanceolate, involute at the tip, 3–4 cm. long, about 1 cm. wide: petals oblanceolate or spatulate, equalling the sepals but thinner, keeled on the back; lip adnate to the column more than two thirds of the way, convolute, broadly obovate or triangular, about 3 cm. in width, channeled on the back, three-lobed, lobes obtuse, crispate, lateral lobes papillose below, central lobe sparingly crested above, bearded below (thick tuft of cilia 5–6 mm. long); column elongated, about 2.5 cm.: anther terminal, jointed at the base, pollinia two: stigma shortly transverse: ovary fleshy, flattened, sometimes slightly two-edged, incurved, 3–3.5 cm. long, 5 mm. wide: capsule elongated.

Collected on both islands, not common. New Providence, Feb.; in bloom, July; London Creek, May; Deep Creek, June (545).

PLATE 3. *Vanilla articulata.* Cluster of flowers; *c*, lip; *a*, *n*, sepals; *d*, petal; *o*, column, side view; *v*, column, front view; *m*, cross section of buds.

CRANICHIS sp.? near *C. tenuis* Reich. Leaves lanceolate, 6–8 cm. in length; petioles equalling or exceeding the leaves; scape very slender, few-flowered, 22 cm. in length, few small sheathing scales. Two specimens only, Conch Sound, May (567).

CRANICHIS sp.? In fruit, possibly *C. muscosa* Sw. but the scape is much more densely flowered than in Wright 620 from Cuba. Conch Sound, March (417).

STENORHYNCHUS ORCHIOIDES Rich. Not common. Flowers greenish. Conch Sound, May (412).

GYROSTACHYS PERUVIANA (Aubl.) Kuntze? Common and vari-

able. Collected on both sides of Andros, Conch Sound, March; Red Bays, April (399, 574). Bracts more acuminate than in Wright 3296. (*Spiranthes tortilis* Rich.?)

LIMODORUM TUBEROSUM L. Common on savannas on west side of Andros. Variable, some specimens approach *L. graminifolium* (Ell.) Small. Red Bays, April, May (430–500). Same as Wright 3317 from Cuba.

### CASUARINACEAE

CASUARINA EQUISETIFOLIA Forst. "Spanish cedar." Nassau, Feb. Common in cultivation (297, 454). 454 was collected on the west shore of Andros, miles from any settlement. It is also reported from the Florida Cays.

### MYRICACEAE

MYRICA CERIFERA L. "Wax-berry," "mickle-berry." Common on Andros. Nicol's Town, March; Lisbon Creek, July (357).

### MORACEAE

FICUS DIMIDIATA Griseb. "Fig-tree." Nassau, Jan.; Nicol's Town, March (119, 377, 378). 119 is the same as Wright 542, 377 and 378 are probably *F. dimidiata* with young leaves.

FICUS PEDUNCULATA Willd. "Fig-tree." Nassau, Jan. (46). Same as Wright 1684.

FICUS PERTUSA L. Mastic Point, Andros, May (586). Same as Wright 545.

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FICUS INDICA L. "Banyan." Cultivated, Nassau, Jan. (295).

ARTOCARPUS INCISA L. f. "Breadfruit." Cultivated (261).

### ULMACEAE

TREMA LIMA (Lam.) A. S. Hitch.? (*Sponia Lamarckiana* Desc.) "Wild birch," "wild fig." Common in the coppet at Red Bays (Lewis Coppet), April; Deep Creek, June.

A low tree, not tortuous branching. In general appearance and mode of branching seems between *T. mollis* Desc. and *T. Lima*. The leaves are larger than any specimen of *T. Lima* examined, 4–5 cm. long, .5–2.5 cm. broad; upper surface very scabrous,

apex acute. It is the same as Cooper 21 from New Providence and Eggers 2326, unnamed (485, 683).

URTICACEAE

FLEURYA AESTUANS Gaud. Nassau, Jan. (30).

ADICEA MICROPHYLLA (Sw.) Kuntze. Nassau, Jan. (29).

LORANTHACEAE

DENDROPEMON EMARGINATUS (Sw.) Steud. Nicol's Town, March. On fig, gum-elemi, etc. (373). Agrees with Wright 1303, except that racemes are shorter and the pedicels longer.

DENDROPEMON sp. "Mistletoe." Mars Bay, Andros; on *Peltophorum*, July (713). Plants smooth, branchlets and peduncles much compressed.

PHORADENDRON RACEMOSUM Kr. & Urb. "Snake-root," "big man." Deep Creek, June; on *Nectandra* (704). Same as Eggers 1741 and Wright 1252 *p. p.*

**Phoradendron Northropiae** Urban, sp. nov.

Ramis teretibus v. junioribus plus minus compressis, superne di-v.-trichotomis: vaginis cataphyllaribus ad omnia internodia supra basin obviis solitariis, raro binis: foliis obovatis v. breviter obovatis antice rotundatis v. sub-truncatis, plerumque late emarginatis, basi sensim v. satis abrupte in petiolum 2–6 mm. longum angustatis, 3–7 cm. longis, 2.5–4 cm. latis, vix dimidio usque duplo longioribus quam latioribus, partissime et obsolete pinnatinervibus, crasse coriaceis; spicis ad nodos pluribus lateralibus, 1.5–2.5 cm. longis; 4–6 articulatis: articulis androgynis, 10–14 floris v. 1–2 supremis 6–2-floris; floribus in seriebus 4 dispositis, imparibus 2 sub apice cujusque articuli adjectis, hisve masculis, caeteris femineis, baccis non visis.

Rami inferne 3–5 mm. crassi, glaberrimi, internodiis 4–10 cm. longis. Folia in sicco olivacea v. brunnescentia, nervis lateralibus utrinque plerumque 2, altero supra basin, altero ad medium e nervo medio abeunte, supra vix, subtus paullo melius conspicuo. Spicae interdum revera ex axillis euphyllorum solitariae, sed utrinque accessoriis autae ideoque pro axilla specie ternae, sed plerumque ad nodos vetustos inordinate plures, ex axillis squamarum minutarum orientes, 3–5 mm. longe pedunculatae.

Hab. in Ins. Bahamas, Andros Island ad Conch Sound and Lisbon Creek, in June flor. Northrop no. 551 (in *Mimusops depressa* Pierre).

PLATE 4. *Phoradendron Northropiae.* Portion of plant × ¾; *a*, inflorescence.

ARISTOLOCHIACEAE

ARISTOLOCHIA PASSIFLORAEFOLIA Rich. Conch Sound, May. In the pines (568). Same as Wright 3665.

ARISTOLOCHIA PENTANDRA L. Nicol's Town, March (385). Same as specimens of Garber and of Curtiss from South Florida.

POLYGONACEAE

COCCOLOBIS DIVERSIFOLIA Jacq. Nassau, Jan. (143). Determined at Kew by Dr. N. L. Britton. Same as Brace 142 "var. foliis minoribus" Lindau.

COCCOLOBIS RETUSA Griseb. "Pigeon-plum." Deep Creek, June (705); Purser Pt., June (662); low in fruit. Same as Wright 2252.

COCCOLOBIS TENUIFOLIA L. Nicol's Town, April (443). Determined at Kew by Dr. N. L. Britton. Same as Wright 3368. Same as Brace 151, 193 and 205.

COCCOLOBIS UVIFERA (L.) Jacq. "Sea-grape." Nassau, Jan. Common everywhere along north shore of New Providence and east shore of Andros (80).

COCCOLOBIS WRIGHTII Lindau. "Pigeon-plum." Deep Creek, July (721). Determined at Kew by Dr. N. L. Britton. Same as Wright 1395.

COCCOLOBIS OBTUSIFOLIA Jacq. "Pigeon-plum." Deep Creek, June (706). Determined at Kew by Dr. Britton to be the same as Eggers 4486, which according to Lindau is *C. microstachya ovalifolia* Meisn.

POLYGONUM PORTORICENSE Bertero. (*P. densiflorum* Meisn.) Fresh Creek, June. Not common (621).

ANTIGONUM LEPTOPUS H. & A. Common in cultivation. Nassau and Mastic Pt., June (604).

CHENOPODIACEAE

ATRIPLEX CRISTATA H.B.K. Deep Creek, June (709).

SALICORNIA AMBIGUA Michx. Common along the east coast. Nassau, Jan. (171).

SALICORNIA BIGELOVII Torr. (*S. mucronata* Bigel.) In the "swash" on the west side of Andros. Wide Opening, June (669). 3 dm. in height, branches very strict.

DONDIA FRUTICOSA (Forsk.) (*Suaeda.*) Red Bays, April (455). 7–8 dm. in height, rigid, much branched.

DONDIA LINEARIS (Ell.) Millsp. Common. Nassau, Jan. (194).

### AMARANTACEAE

ALTERNANTHERA MUSCOIDES Sw. Lake Waterloo, Nassau, Jan. (150).

ALTERNANTHERA PARONYCHIOIDES St. Hil. Nassau, Jan. (197). Same as Eggers 2571 (not named specifically), except that the plant is more compact and the petioles shorter, 3–4 mm.

LITHOPHILA VERMICULARIS (L.) Uline. "Sampire." Ft. Montague, Nassau, Jan. Common on sandy shores (147).

IRESINE PANICULATA (L.) Kuntze. (*I. celosioides* L.) "Newburn weed." Nicol's Town, March; Stafford Creek, June (362).

### BATIDEAE

BATIS MARITIMA L. Mastic Pt., May; Cormorant Cay, Andros, June (595).

### PHYTOLACCACEAE

RIVINA HUMILIS GLABRA L. Common on N. P. and Andros. Nassau, Jan. (20).

PHYTOLACCA OCTANDRA L. "Poke-bush." Nicol's Town, March (354).

### NYCTAGINACEAE

MIRABILIS JALAPA L. "Four-o'clock." Naturalized in Nassau, Jan.

BOERHAAVIA ERECTA L. Near caves, New Providence, Feb. (280).

BOERHAAVIA PANICULATA Rich. Mastic Point, Andros, May (732).

BOERHAAVIA SCANDENS L. Near caves, New Providence, Feb. (281).

PISONIA ACULEATA L. "Cockspur." Common in the coppet of both islands. Nassau, Jan. (73, 196).

PISONIA OBTUSATA Sw. In the coppet, Nicol's Town, April (517). Same as a specimen of Blodgett's from Key West, named by Torrey.

PISONIA ROTUNDATA Griseb. In the coppet, not common. Fresh Creek, June (636). Same as Wright 3369, also specimens of Blodgett's from Pine Key, Fla.

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BOUGAINVILLEA SPECTABILIS Poir. Common in cultivation at Nassau (142).

AIZOACEAE

SESUVIUM PORTULACASTRUM L. Common on sandy beaches on both islands, variable. Nassau, Jan. (149).

PORTULACEAE

PORTULACA OLERACEA L. Common prostrate form, collected at Nassau, Jan.

PORTULACA OLERACEA L. var.? Plants 2–2.5 dm. high, ascending, nearly erect; leaves 1–2.25 cm. in length, obtuse or sometimes retuse, axils shortly and sparsely pilose: flowers larger than in the common form, clustered: petals 4–5 mm.: sepals strongly carinate-winged: style 3–4-parted: seeds small, less than .5 mm., rugose. Found growing abundantly on Cormorant Cay in the Northern Bight, west side of Andros, June (658).

PORTULACA HALIMOIDES L. Conch Sound, May. Common on rocks (580).

ANONACEAE

ANONA PALUSTRIS L. "Custard apple." Not uncommon in swampy parts of the coppet. Conch Sound, March (408). Same as Rugel 710.

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ANONA SQUAMOSA L. "Sugar apple." Nicol's Town, cultivated (513).

RANUNCULACEAE

CLEMATIS DIOICA L. Collected by Mr. Alexander Keith at Conch Sound, 1894. Not common (742).

LAURACEAE

NECTANDRA SANGUINEA Rottb. "Sweet torchwood." Common in the coppet. Conch Sound, Red Bays, April; Fresh Creek, June (487, 613). Agrees with Wright 484 except that the leaves are narrower (2.5–3 cm.).

CASSYTHA FILIFORMIS L. Common on shrubs and low trees. Nassau, Jan. (78, 104, 512). A more slender form with yellow stems was found on low grasses at Loggerhead Creek on the west side of Andros, also found on Rose Island, N. P. (266).

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PERSEA PERSEA (L.) Cockerell. "Avocado pear." Common in cultivation. Nicol's Town, March (371).

PAPAVERACEAE

ARGEMONE MEXICANA L. Common about Nassau, Jan. (51).

CRUCIFERAE

BRASSICA ARVENSIS (L.) B.S.P. (*B. Sinapistrum* Boiss). Nassau, Jan. (225). Leaves almost entire.

LEPIDIUM VIRGINICUM L. Nassau, Jan. (140).

CAKILE AEQUALIS L'Her. Common on sandy beaches. Salt Cay, Feb. (88, 278). Same as Wright 1863.

CAPPARIDACEAE

PEDICELLARIA PENTAPHYLLA (L.) Schrank. "Wild mustard." Fresh Creek, June (630).

CRASSULACEAE

BRYOPHYLLUM PINNATUM (Lam.) S. Kurz. (*B. calycinum* Salisb.) "Live-for-ever." Nassau, Jan.; also on Andros (199).

ROSACEAE

CHRYSOBALANUS ICACO L. "Pigeon plum." Common on sandy shores. Nassau, Jan.; Fresh Creek, June. Many specimens at latter locality had white drupes (115).

MIMOSACEAE

ACACIA CHORIOPHYLLA Benth. "Cinnecord." Common in the pines on both islands. New Providence, Feb.; Nicol's Town, March (312, 364).

ACACIA FARNESIANA (L.) Willd. Nassau, Jan. (44).

ACUAN DEPRESSA (Kunth.) Kuntze. (*Desmanthus.*) Red Bays, April (495).

ACUAN VIRGATA (Willd.) Kuntze. (*Desmanthus.*) Mastic Pt., May (731).

MIMOSA PUDICA L. "Sensitive plant." Collected by Mr. Keith, 1891. Uncommon on Andros, but said to be abundant on Eleuthera. Mastic Pt. (735).

LEUCAENA GLAUCA (L.) Benth. "Jumby-bean." Nassau, Jan., Feb.; Bearing Point, Andros, June (43, 282, 657). Nos. 282 and 657 were shrubs, 1.5–2 m. in height.

LYSILOMA PAUCIFOLIOLA (DC.) A. S. Hitch. (*Sabicu* Benth.) "Horseflesh," "sabicu." Common in the coppet; one of the most valuable timber trees. Nicol's Town, April; Deep Creek, June (434).

LYSILOMA BAHAMENSIS Benth. "Wild tamarind." New Providence, Feb. (309). Same as Wright 3542.

CALLIANDRA FORMOSA Benth. Hog Island, Nassau, Feb. (255). In fruit only. Determined by Dr. B. L. Robinson at Gray herbarium.

PITHECOLOBIUM HYSTRIX Benth. (*P. calliandraefolium* Wright) In the pines, not common. Conch Sound, May; Deep Creek, June (575). It is the same as Wright 2401.

PITHECOLOBIUM UNGUIS-CATI (L.) Benth. "Ram's horn." Common near the shore on both islands. Nassau, Jan.; Cocoanut Pt. Andros, April (66, 235, 449). 66, collected at Nassau, has the leaves two-jugal and agrees with Eggers (3830).

**Pithecolobium Bahamense** sp. nov. "Ram's horn."

A shrub, 1.5–2 meters in height, with slender, drooping branches, armed with delicate, stipular spines, 3–7 mm. in length; leaves bipinnate, pinnae one-jugal, leaflets one-jugal; petiole 1–4 mm. in length, petiolules 1–3 mm., channelled and with a single stipitate gland at the base; leaflets oblong to oblanceolate or obovate, 1.25–2 cm. long, a little over half as broad, obtuse or mucronate at the apex, oblique and slightly unequal at the base, chartaceous, glabrous, shining above, entire, subsessile with a stipitate gland at base: inflorescence capitate, many-flowered: peduncles 2–3 cm. in length, much exceeding the leaves: calyx tubular, less than one half the length of the corolla with five ovate

acute lobes: corolla crimson, tubular, 3–5 mm. in length, five-lobed, lobes acute, about one half as long as the tube: stamens numerous, crimson, exserted, more than twice the length of the corolla: anthers small, rounded: ovary stipitate: style much exserted, about 2 cm. in length, four times as long as the corolla: stigma small: immature fruit compressed, slightly curved, puberulent: mature fruit 9 cm. in length, 1 cm. in width, dark-brown, curved: seeds arilled.

Collected in fruit near Nassau in January, and in flower in the coppet at Mastic Point, Andros, in June (605). The plant belongs to the section *Unguis-cati* and is related to *P. circinale* Benth.

PLATE 5. *Pithecolobium Bahamense.* Portions of plant in flower and in immature fruit. × ⅔.

CAESALPINACEAE

CASSIA BAHAMENSIS Mill. "Stinking pea." New Providence, Jan. (103).

CASSIA BIFLORA L. Nassau, Jan. Leaflets strongly emarginate (55).

CASSIA LIGUSTRINA L. Common. Nassau, Jan.; Conch Sound, March (123, 422). Same as Wright 1190.

CASSIA MIMOSOIDES L. Nassau, Jan. Pods 2–2.5 cm. long, very hairy (134).

CASSIA OCCIDENTALIS L. Nassau, Jan. (105).

CASSIA POLYADENA DC. Nicol's Town, March. In the pines, strict and unbranched, 7–9 cm. in height, not as pubescent as Wright 2376.

CASSIA VILLOSA Mill. Nassau, Jan. Determined by Miss Anna Murray Vail at Columbia herbarium (14).

**Cassia Caribaea** sp. nov.

Shrubby, 6–9 dm. in height; stem gray, smooth: leaves 2–3.5 cm. long, with from two to four pairs of leaflets, mostly three; petiole 2–5 mm. long, channelled: a stipitate gland between the leaflets or slightly below (often wanting between the lowest pair); leaflets sessile, elliptical, 1.5–2 cm. long, about one third as wide, unequal and oblique at the base, apex mucronate, margin entire, thickish, glabrous, shining above, resinous-dotted below; veins numerous, parallel and prominent; stipules about 3 mm. in length, subulate, subspinescent, ribbed and often with appressed white hairs on the margin, persistent: flowers large, solitary, axillary: peduncle 2–3 cm. long: calyx deciduous: sepals lanceolate, acuminate, about

1 cm. long, the three outer ones keeled, keel pilose : petals yellow, oblanceolate or obovate, nearly twice as long as the sepals and about 1 cm. in width : stamens 10, the three upper difform : anthers linear, puberulous along the furrow, bursting at the top by two short clefts : ovary about 5 mm. in length, shorter than the flattened style and covered with appressed white hairs : legume purplish-brown, linear-oblong, 3–5.5 cm. long, 5–7 mm. wide, bivalved, compressed, mucronate, with a few scattered hairs : seeds about eight, oblong, compressed.

Collected in the coppet at Fresh Creek, Andros, June 10, most closely related to *C. lineata* Sw. (638).

PLATE 6. *Cassia Caribaea.* Portions of plant, natural size; 1, leaflet.

TAMARINDUS INDICA L. "Tamarind." Fresh Creek, June; Deep Creek, July (642, 717).

HAEMATOXYLON CAMPECHIANUM L. "Logwood." Nassau, Jan.; Lisbon Creek, Andros. Naturalized (195).

CAESALPINIA OVALIFOLIA Urban. "Nicker-bean." Nassau, Jan. (116). Described in Symbolae Antillanae, **2**: 273. O. 1900.

CAESALPINIA CRISTA L. (*C. Bonducella* L.) "Nicker-tree." Nassau, Jan. (106). Both species quite common on New Providence and Andros on sandy beaches.

CAESALPINIA RUGELIANA Urban. Common in the pines. Conch Sound, March (426). Same as Wright 2364.

PELTOPHORUM ADNATUM Griseb. "Horse-bush." Upper surface of leaflets hirsute. Otherwise same as Wright 2359. Deep Creek, July (712).

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POINCIANA REGIA Boj. "Poinciana," "flamboyant." Cultivated at Nassau, Mastic Pt. and Deep Creek, Andros (591).

CAESALPINIA PULCHERRIMA Sw. "Pride of Barbadoes." Cultivated at Nassau and Mastic Pt. (10).

PAPILIONACEAE

SOPHORA TOMENTOSA L. Conch Sound, March; Deep Creek, July (411, 727). Same as Eggers 2573, but is not nearly as tomentose.

CROTALARIA PUMILA Ort. Nassau, Jan. (67). Same as Curtiss 533.

CROTALARIA RETUSA L. Nassau, Jan. 221. Same as Wright 117.

CROTALARIA VERRUCOSA L. Nassau, Jan. (54).

INDIGOFERA ANIL L. Nassau, Jan. (175).

CRACCA SCHOTTII Vail. In old field, Lisbon Creek, Andros, June (678). Agrees with specimens from Cartagena, Schott, no. 16. Determined by Miss Anna Murray Vail.

STYLOSANTHES HAMATA (L.) Taub. (*S. procumbens* Sw.) Nassau, Jan. (37).

MEIBOMIA INCANA (Sw.) Kuntze. (*Desmodium incanum* (Sw.) DC.) Nassau, Jan. Common (224).

ABRUS PRECATORIUS L. "Crab's eyes," "Black-eyed-Susan," "Wild licorice." Nassau, Jan. (239).

BRADBURYA VIRGINIANA (L.) Kuntze. (*Centrosema.*) Very common, fruit and leaves variable. Nassau, Jan.; Fresh Creek, June (82, 227, 629).

BRADBURYA VIRGINIANA ANGUSTIFOLIA (DC.) Griseb. Fresh Creek, June (756).

GALACTIA RUDOLPHIOIDES (Griseb) Wright. Common. Nassau, Jan.; Nicol's Town, March, April (214, 219, 395). Agrees with Wright 1181.

GALACTIA CUBENSIS H.B.K. (*G. spiciformis* T. & G.) Nassau, Jan.; Fresh Creek, June (60, 226, 648). Agrees with Wright 2332.

CANAVALIA OBTUSIFOLIA (Lam.) DC. "Horse-bean." Common on sandy beaches. Nassau, Jan.; Conch Sound, April (112, 452). Legume 2.5 cm. wide. Same as Curtiss 682, and Eggers 2724, unnamed specifically.

DOLICHOLUS MINIMUS (L.) Medic. Nassau, Jan. (215). Same as Curtiss 656.

PHASEOLUS SEMIERECTUS L. Common. Southwest Beach, N. P., Jan.; Mangrove Cay, Andros, June (329). Same as Wright 137.

VIGNA REPENS (L.) Kuntze. Nicol's Town, March (386). Same as J. Donnell Smith 181, Pl. Guat.

CAJANUS CAJAN (L.) Millsp. "Pigeon-pea." Cultivated and escaped on both islands. Nassau, Jan. (98).

DALBERGIA BROWNEI (Pers.) Kuntze. "Ti-ti." Kemp Sound, Andros, June (680).

ICHTHYOMETHIA PISCIPULA (L.) A. S. Hitch. (*Piscidia Erythrina* L.) Conch Sound, May (588). Same as Curtiss 685.

ARACHIS HYPOGAEA L. "Groundnut." Cultivated. Mastic Point, May (600).

ERYTHRINA CORALLODENDRON L. "Lightning-tree." Cultivated. Nassau (308).

OXALIDACEAE

OXALIS CORNICULATA REPENS Zucc. Nassau, Feb. (330).

OXALIS sp. Acaulescent, bulbs scaly; leaflets broadly obcordate, about 5 cm. wide and 2 cm. long; petioles 14–16 cm., a little longer than the scape: flowers pale purple, about 1 cm. wide. Near *O. latifolia* Kunth. Nassau, Feb. Probably escaped (331).

LINACEAE

**Linum Bahamense** sp. nov.

Suffruticose, 3–6 dm. in height, corymbosely branched, branches erect-ascending: stems sulcate: leaves numerous, alternate, sessile, appressed-ascending, whitish, linear-lanceolate, 8–11 mm. long, a little more than 1 mm. wide, one-nerved, the midrib prominent on the under side and projecting at the apex so as to form a mucro, margin entire or the younger leaves glandular-ciliate, glabrous or with a few scattered hairs at the base or along the midrib on the upper side; two dark stipular glands at the base of the leaves: flowers corymbose, numerous; pedicels short, 2 mm. in length, bracts ciliate-glandular: sepals 5, lanceolate, acuminate, 2–3 mm. long, ciliate-glandular, keeled, persistent: petals bright yellow, more than twice the length of the sepals, obovate: stamens 5, united at the base included: anthers oblong: styles 5, distinct, filiform: ovary globose, imperfectly 10-celled; ovules 10; capsule globose, 2–3.5 mm. in diameter, about as long as the calyx, splitting into 10 valves; seeds oblong, compressed, reddish-brown (204, 496).

Common in the pines on both islands. Collected at Lake Waterloo near Nassau, Jan. 25; near Southwest Beach, N. P., Feb. 26; at Red Bays on the west side of Andros, April 17; also collected in N. P. by Eggers, no. 4181.

This is related to *L. sulcatum* Riddell, but the styles are distinct, the leaves are one-nerved and the septa of the capsule are not glandular.

PLATE 7. *Linum Bahamense*. Entire plant, × $\frac{2}{3}$; *t*, flowers and buds; *r*, sepal; *a*, petal; *s*, stamen; *u*, anther; *p*, fruit.

ERYTHROXYLON BREVIPES DC. "Rat-wood." Deep Creek, June (692). Same as Wright 2134 and Eggers 2435 unnamed specifically.

ERYTHROXYLON OBOVATUM **Macf.** Mastic Point, May (597). Same as Eggers 4345 from Bahama; leaves thicker and veining more conspicuous than in Wr. 2140 from Cuba.

**Erythroxylon reticulatum** sp. nov.

Tall shrub with slender branches: reddish-brown verrucose bark, branchlets strongly compressed: leaves oblanceolate or oblong, 2.5–3 cm. long, half as wide; broadly obtuse and mucronulate at the apex, narrowed below to a short petiole, 2–3 mm. long, glabrous, thickish, entire, dull green above, pale below, areolate, the reddish connecting veins circumscribing a central area 4–6 mm. wide; midrib reddish, prominent, veins delicate, prominulous above: stipules persistent, triangular, acuminate, shorter than the petioles, reddish-brown: flowers axillary, appearing with the leaves, solitary or sometimes in pairs; pedicels 5–8 mm. long, slender below, gradually thickening and wing-angled above: calyx spreading; sepals 5, lanceolate, about one third the length of the petals: petals white, 3–3.5 mm. in length, deciduous, elliptical-oblong, slightly keeled on the back, internal scale two-lobed and contorted at the apex: stamens 10, 4–5 mm. long, exserted: filaments united over one third of the way, tube extending a little beyond the sepals: ovary oblong, 3-celled: styles 3, distinct: stigmas flattened, reddish: young drupe oblong, pointed, purplish-black, 5 mm. in length.

Collected at Deep Creek, Andros, June 27; growing in sand (682). Most nearly related to *E. areolatum* L.

PLATE 8. *Erythroxylon reticulatum.* Portion of plant, × $\frac{6}{7}$; *a*, flowering branch; *d*, flower without corolla; *n*, petal.

MALPIGHIACEAE

BYRSONIMA LUCIDA Rich. Common on Andros on the edge of the coppet. Our specimens resemble those from Florida more closely than they do those from the West Indian specimens; the latter all have broader, obovate, instead of oblanceolate or spatulate leaves. Nicol's Town, March (367). Same as Curtiss 501. Largest specimen seen one foot in diameter and about twenty feet in height.

MALPIGHIA SETOSA Spr. "Touch-me-not." Fresh Creek, June (737). Determined by Dr. Britton at Kew to be "the same as a specimen marked *M. setosa* by Jussieu; collected also by Brace no. 114."

A number of specimens were collected at various times which

seem to vary greatly; possibly more than one species is represented. No. 737 was collected in the pines at Fresh Creek. It was a tall shrub with whitis hbark, oblong leaves, 2–3.5 cm. long, 12–20 mm. wide, entire or nearly so, hairs few on margin and under surface: inflorescence, two-flowered umbels; pedicels 8–13 mm.: flowers rosy, 12–15 mm. wide: drupe globose, furrowed.

No. 538 was a single specimen from the pines at Stafford Creek, collected in May, differs from the above in having thicker narrower leaves only half as wide, 2–3 cm. long and 8–10 mm. broad, pointed at base and apex, margin dentate or strongly denticulate. No. 538*a* is a specimen in fruit, collected at Conch Sound; leaves broader than in above, denticulate and with hairs on both sides of the leaf, 538*b*, also from Conch Sound, sent by Mr. Keith, has oval or ovate leaves 2–2.5 cm. wide, with strongly dentate margins, hairs beneath and on the margin, flowers smaller than in 737. All the above specimens differ very much from Wr. no. 99, marked *M. setosa*, in leaf only; that has leaves less than half the size of any of ours, hairy above and strongly hirsute beneath.

STIGMATOPHYLLON SAGRAENUM Juss. Not uncommon in the pines. Conch Sound, March; Red Bays, April (401–468). Same as Rugel 157.

TRIOPTERIS RIGIDA Sw. Common in the coppet. Nassau, Feb.; Conch Sound, May; Calabash Cay, Andros, June (217). Same as Wr. 96. 217*a* from Deep Creek has the leaves oblanceolate or obovate, 12–17 mm. wide; all the other specimens collected have oblong or elliptical leaves 7–10 mm. wide.

## RUTACEAE

FAGARA FLAVA (Vahl) Krug & Urban. (*Xanthoxylon cribrosum* Spreng.) "Satin-wood." Deep Creek, June (695).

FAGARA CORIACEA (A. Rich) Krug & Urban. (*Xanthoxylon emarginatum* Wright.) "Hercules' club." Common in the coppet. Nicol's Town, March; Mastic Pt., April; Deep Creek, June (372). Same as Eggers 4034, 4503, Brace 510. Carpels globose, not oblique.

FAGARA FAGARA (L.) Small. (*Fagara lentiscifolia* Willd.) Nassau, Nicol's Town (747).

SIMARUBEAE

SURIANA MARITIMA L. "Bay-cedar." Common along the shore on both islands. New Providence, Jan. (86). Same as Eggers 2728.

PICRODENDRON BACCATUM BAHAMENSE Krug & Urban. Conch Sound, April (453). Determined at Kew by Dr. Britton. Same as Eggers 4402, Brace 476.

BURSERACEAE

BURSERA SIMARUBA (L.) Sarg. "Gum-elemi," "West Indian birch." Common on both islands. Nassau, Jan.; Conch Sound, May (64, 560).

SWIETENIA MAHOGANI L. "Madeira." Nassau, Jan.; Mangrove Cay, June (137, 676). Same as Eggers 1836, Wright 1153.

POLYGALACEAE

POLYGALA BOYKINII Nutt. Common on savannas on west side of Andros. Red Bays, April (473).

POLYGALA BRIZOIDES St. Hil. Common in savannas on west side of Andros. Red Bays, April (465). Determined at Kew by Mr. A. W. Bennett — "sed racemi quandoque axillares."

POLYGALA SPATHULATA Griseb. Conch Sound, March (402). Determined by Mr. A. W. Bennett at Kew.

EUPHORBIACEAE

BUXUS BAHAMENSIS Baker. On savanna. Near the shore at Red Bays, April (460). Determined by Dr. B. L. Robinson at Gray herbarium.

PHYLLANTHUS EPIPHYLLANTHUS L. (*P. falcatus* Sw.) "Hard-head." Common on both islands. Nassau, Feb.; Nicol's Town, March (146–325). Same as Eggers 7234. Branchlets narrower than in Wright 1951. No. 146*a* and 146*b* have branchlets very narrow, 8–10 cm. long and 6–8 mm. wide, apex more acute, pedicels longer and more slender, 3 mm. in length.

PHYLLANTHUS DISTICHUS L. "Gooseberry tree." Fresh Creek, June, escaped (653).

PHYLLANTHUS NIRURI L. Nicol's Town, March (338).

PHYLLANTHUS BAHAMENSIS Urb. Lewis Coppet near Red Bays, Andros, May (488). Same as Eggers 4241, 4464.

SAVIA ERYTHROXYLOIDES Griseb. "Maiden-bush." Not unfrequent in the coppet. Fresh Creek, Deep Creek, June. In fruit only (610). Determined by Mr. M. L. Fernald.

CROTON LINEARIS Jacq. (*C. Cascarilla lincaris* Jacq.) "Granny-bush." Common along the eastern shores of both islands. Nassau, Jan.; Fresh Creek, June (113, 615).

MANIHOT MANIHOT (L.) Cockerell. (*Jatropha Manihot* L.) "Sweet cassava." Cultivated and escaped. Nicol's Town, March (363).

ACALYPHA ALOPECUROIDES Jacq. Nassau, Jan. (32). Same as Wright 571.

LASIOCROTON MACROPHYLLUS Griseb. "Wild oak," "Light-wood," "Bitters." Deep Creek, June (689). Agrees with specimen of March from Jamaica except that the upper surface of the leaves is smooth instead of velvety and the apex is obtuse instead of acute.

EXCOECARIA LUCIDA Sw. "Crab-wood." Nicol's Town, March; Fresh Creek, June (375).

EXCOECARIA SAGRAEI J. Müll. Stafford Creek, Andros, May (589). Same as Wright 2006.

HIPPOMANE MANCINELLA L. "Manchineel." Not uncommon on Andros. Conch Sound, May; Fresh Creek, June (556, 622). In 662 the sap did not seem at all milky. All the herbarium specimens examined showed the leaf apex acute or acuminate, while all of ours have the apex very blunt.

BONANIA EMARGINATA DC. Fresh Creek, June (628).

PEDILANTHUS sp.? possibly *P. angustifolius* Poit.

Shrubby, 7–9 cm. high, half-scandent with green, rather fleshy stems, very little branched. All the plants seen were destitute of leaves though alternate leaf-scars are discernible, 4–5 cm. apart; scars of the floral leaves opposite: flowers in terminal cymes; peduncles 4–5 cm. in length; involucre bright red, pubescent, about 8 mm. long, irregular, with a sharp spur at the side, 5 mm. long; spurred part of involucre with four glands at base: staminate flowers indefinite: pistillate ones exserted: style 10 mm. in length.

Collected in two localities in the coppet at Deep Creek, June (693).

Resembles *P. angustifolius* Poit. as shown by 769 Pl. Sintenis in Gray herbarium, but specimen not in good flower.

EUPHORBIA BLODGETTII Engelm. Nassau, Jan.; Nicol's Town, March (41, 379).

EUPHORBIA BUXIFOLIA Lam. Common on sandy beaches. Southwest Beach, N. P., Jan.; Red Bays, April (87, 457). 672, a form with leaves not appressed, was collected at Big Cabbage Creek on the west side of Androsin June. Same as Wright 2016.

EUPHORBIA CASSYTHOIDES Boiss. Rare, Deep Creek, June (702). Determined at Kew, 1897.

EUPHORBIA HETEROPHYLLA L. Common in the pines. New Providence, Jan. (96).

EUPHORBIA HETEROPHYLLA GRAMINIFOLIA Engelm. Same locality (92).

EUPHORBIA NUTANS Lag. Common. Nassau, Jan.; Nicol's Town, March (229, 380). Our specimens agree with Professor Hitchcock's in having the upper internodes slender, especially in 229, and no dark spots on the leaves. (See Hitchcock's Report, Plants of the Bahamas, Jamaica and Grand Cayman.)

EUPHORBIA SERPENS Kunth. Nassau, Jan. (277). Same as specimen of Rugel, no. 148 marked *E. serpens* var.? Much branched, delicate, with slender wiry stems, enlarged nodes, leaves 3–4 mm. in length.

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EUPHORBIA PULCHERRIMA (Graham) Boiss. "Poinsettia." Nassau, common in cultivation.

EUPHORBIA ANTIQUORUM L. Nassau, cultivated.

HURA CREPITANS L. "Sand-box tree." Nassau, cultivated.

### ANACARDIACEAE

METOPIUM METOPIUM (L.) Small. "Poison-wood." Common in the coppet on both islands. Nassau, Jan.; Conch Sound, May (70, 552). Same as Wright 2287, Curtiss 448.

### MORINGACEAE

MORINGA MORINGA (L.) Small. "Horse-radish tree." Nassau, cultivated (310).

### CELASTRACEAE

ELAEODENDRUM XYLOCARPUM DC. Nassau, Jan. (71). In fruit only. Determined by Mr. M. L. Fernald, Cambridge.

MAYTENUS BUXIFOLIUS (Rich.) Griseb. Fresh Creek, June.

Differs from Wr. 2215 and all other specimens examined in having the leaves narrower and more spatulate, 2–2.5 cm. long, 6–9 mm. wide (626).

CRASSOPETALUM PALLENS (Smith). (*Myginda pallens* Smith.) Cocoanut Point, April; Deep Creek, June (447, 718). Like Eggers 4140 and 4438 from New Providence, "put with *M. pallens* at Kew." Differs from the Florida specimens in having much narrower leaves, oblanceolate or spatulate, 2–2.5 cm. long, 4–9 mm. wide.

**Crassopetalum coriaceum** sp. nov.

Low shrub: branches ascending, bark grayish; branchlets tetragonal, ends somewhat wing-angled: leaves numerous, opposite, subsessile, coriaceous, broadly oblanceolate, 1.5–2 cm. long, about 1 cm. wide, apex obtuse or sometimes slightly retuse, base cuneate, margin entire, somewhat revolute, veins inconspicuous: flowers minute, reddish, in axillary subsessile cymes, 2–5-flowered; pedicels 1–2 mm. in length, jointed; pedicels and calyx puberulous: calyx campanulate, persistent; lobes 4, rounded, reddish, obtuse: petals 4, orbicular, longer than the calyx, spreading or at length reflexed: stamens 4, inserted on the edge of the disk; filaments subulate; anthers small, globose: ovary immersed in the disk, globose: style short: stigmas 4: fruit a red drupe, slightly obovate, about 3 mm. in length, one-celled, one-seeded (480).

PLATE 9. *Crassopetalum coriaceum*. Portion of plant × $\frac{5}{6}$; *s*, stamens; *n*, ovary; *a*, fruit.

Collected on the savannas at Red Bays. Andros, April. Allied to *C. pallens* (Smith), but differs in having thicker entire leaves and smaller subsessile cymes.

SCHAEFFERIA FRUTESCENS Jacq. Deep Creek, June (697). Same as Wright 77.

ILICACEAE

ILEX KRUGIANA Loes.; Engler's. Bot. Jahrb. **15**: 317. Conch Sound, May. Upper surface of the leaves shining, apex acute (553). Same as Cooper's 17 from New Providence, and Eggers 1889 from St. Domingo (unnamed).

SAPINDACEAE

SERJANIA DIVERSIFOLIA Radlk. "Fowl-foot vine." Common. Conch Sound, May; Fresh Creek, Deep Creek, June (578, 687). Same as Wright 109.

SERJANIA SUBDENTATA Juss. & Poir. "Fowl-foot vine." Common in the coppet. New Providence, Jan.; Fresh Creek, June (236). Same as Wright 2162.

CARDIOSPERMUM HALICACABUM L. "Balloon vine." Nassau, Jan. (237).

THOUINIA DISCOLOR Griseb. "Quicksilver bush." Nicol's Town, March; Conch Sound, May; Deep Creek, June (368, 590, 686).

EXOTHEA PANICULATA (Juss.) Radlk. Nicol's Town, March (392). Same as Wright 1169.

HYPELATE TRIFOLIATA Sw. "Ebony." Deep Creek, June (690). Same as Wright 2171.

ALVARADOA AMORPHIOIDES Liebm. Nassau, Jan. (145). Same as Wright 2189.

RHAMNACEAE

KRUGIODENDRON FERREUM (Vahl) Urban. (*Condalia.*) Fresh Creek, June (611).

REYNOSIA NORTHROPIANA Urban, Symb. Ant. 3: 315. 1902.

PLATE 10. *Reynosia Northropiana.* Portion of plant × ⅔; *e*, flower; *m*, interior of calyx showing stamens and petals; *a*, stamen and petal; *n*, petal; *d*, pistil.

Red Bays on the west side of Andros, April 23, and at Nicol's Town on the east side, April 28 (510).

REYNOSIA LATIFOLIA Griseb. Common on border of swash on west side of Andros. Purser Point, June (661).

COLUBRINA FERRUGINOSA Brongn. "Bitters." Deep Creek, June (684). Same as Wright 1139.

GOUANIA DOMINGENSIS L. "Chew-stick." Common on both islands. Nassau, Jan. (69).

VITACEAE

VITIS ROTUNDIFOLIA Michx. Common. Conch Sound, May (559).

CISSUS MICROCARPA Vahl. "Bull-vine." Common in the southern part of Andros. Deep Creek, June (694). Same as Wright 72.

CISSUS SICYOIDES L. Conch Sound, May (582). Same as Wright 74.

CISSUS, sp. "Bull-vine." Quite common in the northern part of Andros. Conch Sound, March, May (398). Same as Wright 3514.

PARTHENOCISSUS QUINQUEFOLIA (L.) Planch. (*Ampelopsis quinquefolia* (L.) Michx.) Carmichael, New Providence, Feb. (322). Single specimen.

TILIACEAE

TRIUMFETTA SEMITRILOBA L. Common about Nassau. Jan. (4, 47).

CORCHORUS HIRSUTUS L. Common on both islands. Nassau, Jan.; Nicol's Town, March (202). Same as Wright 2091.

CORCHORUS SILIQUOSUS L. Common about Nassau; very variable in the size of the leaves. Nassau, Jan. (139, 222).

MALVACEAE

SIDA CARPINIFOLIA L. Common. Nassau, Jan. (35). A very strict form with crenate leaves found at Nicol's Town, April (433).

SIDA SUPINA L'Her. Nassau, Feb. (306).

ABUTILON CRISPUM (L.) Medic. Nicol's Town, March (370).

PAVONIA SPICATA Cav. (*P. racemosa* Sw.) Collected by Mr. Alexander Keith at Conch Sound, 1891 (736).

HIBISCUS CRYPTOCARPUS Rich. "Wild cotton." Nicol's Town, March; Deep Creek, June (397). Same as Wright 1575.

HIBISCUS ESCULENTUS L. "Gumbo," "okra." Conch Sound, May. Cultivated and escaped (549).

HIBISCUS TILIACEUS L. Not uncommon along the east coast of Andros. Conch Sound, May (564). Same as Eggers 2632.

CEIBA PENTANDRA (L.) Gaertn. (*Eriodendron anfractuosum* DC.) "Silk-cotton tree," "Ceiba." Nassau, cultivated and escaped? Nassau, Jan. (152).

STERCULIACEAE

HELICTERES SEMITRILOBA Bertero. Fresh Creek, June (664).

**Helicteres spiralis** sp. nov.

A tall shrub; young branches and leaves tawny tomentose: leaves lance-ovate, acute, unequal and cordate at base, 6–9.5 cm. long, 2.5–4 cm. wide, 3–5-ribbed, margin crenulate-denticulate, sometimes with a few large teeth, upper surface pubescent, under tomentose, hairs tawny, stellate: petiole about 1 cm. in length: stipules subulate: inflorescence fascicled, few-flowered; peduncles 1.5–2 cm. long; pedicels glandular at base: calyx campanulate,

1.5–2 cm. long, slightly bilabiate, unequally 5-toothed; lobes acute, densely tomentose, about one fourth the length of the column: petals 5, white, hortly exceeding the calyx, oblong, clawed, subequal, the lower auricled near the base: column 7–8 cm. in length, declined, covered with long mostly simple hairs: stamens 10, arranged in pairs; anthers divergent-oblong; staminodia 5, ligulate: ovary tomentose, 5-celled: styles united, thickened at the apex: pod twisted, oblong, about 4.5 cm. in length: convolutions about ten, tomentose or at length glabrous.

Collected near the mouth of Fresh Creek, Andros, June; also collected at Conch Sound by Mr. Alexander Keith, 1891 (645).

PLATE 11. *Helicteres spiralis.* Portions of plant in flower and fruit × ½ nearly.

MELOCHIA NODIFLORA Sw. Nassau, Jan. (45). Same as Wright 39.

MELOCHIA TOMENTOSA L. Common on both islands. Nassau, Jan.; Nicol's Town, March (253). Same as Wright 40; same as Eggers 1991.

WALTHERIA AMERICANA L. Common on both islands; very variable. Nassau, Jan.; Nicol's Town, March (89, 230, 429).

W. AMERICANA var.? (136, 207). Collected at two different stations in Nassau, differing from all specimens examined in having leaves smaller, 1–2 cm. long, 7–13 mm. wide; marginal teeth not as acute, and in having both leaves and stems covered with stellate hairs; plant tall, less stout than the type.

### HYPERICACEAE

ASCYRUM HYPERICOIDES L. Common in the pines on both islands. Nassau, Jan.; Conch Sound, May (323). Same as Wr. 2129 and Eggers 2047 (unnamed).

### BIXACEAE

**Xylosma ilicifolia** sp. nov.

Shrub 2–3 m. in height; bark grayish, verrucose; usually armed with slender spines 1–4 cm. long, spines often much branched: leaves alternate, variable in shape, oval, oblanceolate or obovate, 2–3 cm. in length, 1–2 cm. wide, coriaceous, shining above, apex acute and strongly mucronate (or sometimes obtuse), margin entire or frequently with one to three large, mucronate teeth on the upper half of the leaf, base cuneate or sometimes obtuse; petiole 1–2 mm. in length: flowers dioecious, minute: staminate greenish, in axillary fascicles of 5–6, very short-pedi-

celled; bracts minute, ciliate: sepals 4–5, ovate, ciliate at apex: stamens 8–10; filaments recurved, longer than the anthers; anthers globose; disk annular: pistillate flowers 2–3 in a cluster; pedicels about 1 mm. in length: sepals 4, lanceolate, ciliate towards the apex: pistil more than twice the length of the sepals, about 1 mm. long: ovary globose: styles two thick, short: stigmas two: disk annular: berry globose, bluish-black, about 5 mm. in diameter, one-celled and four-seeded (124, 388).

Collected at Nassau, Jan.; Nicol's Town, Andros, March 27 and April 9; Fresh Creek, June 10. It is the same as Cooper's 13 from New Providence, marked in pencil by Gray "*Xylosma infestum* ?"; also collected by Gov. Robinson 322; Brace 98 and Eggers 446. Seems to be between *X. infestum* Griseb. and *X. buxifolium* A. Gray; differs from the latter in having the upper surface of the leaves shining, apex mucronate, sepals ciliate, petioles and pedicels shorter, and in the shape and margin of the leaves.

PLATE 12. *Xylosma ilicifolia.* Portion of plant, × ¾; *n*, fruit; *bb*, flower; *a*, sepal; *c*, stamens; *e*, ovary.

### CANELLACEAE

CANELLA WINTERANA (L.) Gaertn. (*C. alba* Murray.) "Wild cinnamon," "Bahama whitewood bark." Not buncommon. Nassau, Jan.; Deep Creek, June (79, 708). Same as Wright 2122.

### TURNERACEAE

TURNERA ULMIFOLIA L. Common on both islands. Nassau, Jan. (57). Same as Wright 209.

### PASSIFLORACEAE

PASSIFLORA ANGUSTIFOLIA Sw. Nicol's Town, Conch Sound, March (389, 427).

PASSIFLORA CUPREA L. "Wild watermelon." Common on both islands. Nassau, Salt Cay, Jan.; Nicol's Town, March (121, 243).

PASSIFLORA MINIMA L. Common. Nassau, Jan.; Salt Cay, Conch Sound, March (216, 242, 428). Same as Wright 1245.

PASSIFLORA MULTIFLORA L. Nicol's Town, March (374). Determined at Kew by Dr. Masters.

PASSIFLORA PECTINATA Griseb. Common on Andros in the pines. Nicol's Town, Conch Sound, March; Red Bays, April (391.)

Determined at Kew by Dr. Masters, who noted, "I do not like to separate this from *P. pectinata*, though it differs." The following constant characteristics were found in all the specimens collected. Leaves deeply contracted below the middle with marginal stipitate glands; petiole with a few stipitate glands towards apex; peduncles as long or longer than the leaves; leaflets of involucre bipinnatipartite, secondary segments long-setaceous; excurrent in a gland; calyx segments ovate-lanceolate; petals oblong; tendrils longer than the leaves.

### CARICACEAE

CARICA PAPAYA L. "Papaw." Deep Creek, July. Cultivated (132).

### CACTACEAE

CEREUS SWARTZII Griseb. "Dildo." On borders of creeks in the southern part of Andros. Deep Creek, June (699). 4 mm. in height, 7.5–10 cm. in diameter.

OPUNTIA SPINOSISSIMA Mill. Along the shore. Fresh Creek, June (652).

OPUNTIA TUNA (L.) Mill. Along the shore. Fresh Creek, June (633).

### LYTHRACEAE

PARSONSIA PARSONSIA (L.) Britton. (*Cuphea Parsonsia* (L.) R. Br.) Near Southwest Beach, N. P., Feb. (318). Same as Eggers 1657.

### RHIZOPHORACEAE

RHIZOPHORA MANGLE L. "Mangrove." Common on both islands; the chief vegetation of the swash. Nassau, Jan. (193).

### MYRTACEAE

CALYPTRANTHES PALLENS Griseb. "White stopper." Common in the coppet. Fresh Creek, Deep Creek, June (641).

MYRTUS PUNCTATA Griseb. (*Anamomis.*) "Naked wood." Deep Creek, June (696).

EUGENIA AXILLARIS (Sw.) Willd. "Stopper." Deep Creek, June (707).

EUGENIA LONGIPES Berg. Red Bays, April; Conch Sound, May (471). Same as Curtiss (985) from Florida.

EUGENIA MONTICOLA DC. Deep Creek, July. In fruit only (725). Same as Curtiss 987.

EUGENIA sp.? Near *E. longipes* Berg.

A tree with smooth white bark, branchlets slender, smooth; leaves thick, at length leathery, pale-green, shining above with pellucid dots; oblanceolate or elliptical, obtuse, mostly cuneate at base, 10–17 mm. long, 5–7 mm. wide; petioles 1–2 mm., veining indistinct: flowers solitary or in pairs on long slender pedicels, 2–2.5 cm. long, bibracteolate; bractlets oblong, about equalling the calyx lobes. Flowers smaller than in *E. longipes*. In general appearance the tree resembles *Myrtus punctata* except that the leaves are smaller.

A single tree seen in the coppet at Deep Creek, July (722).

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PSIDIUM GUAYAVA L. "Guava." Common in cultivation. Nassau, Conch Sound (579).

COMBRETACEAE

CONOCARPUS ERECTA L. "Button-wood." Abundant on both islands. Nassau, Jan.; Cocoanut Point, May (53, 298).

CONOCARPUS ERECTA SERICEA Fors. Nassau, Cocoanut Point (81, 532). Same as Eggers 2608. At Cocoanut Point, both the glabrous type and the variety were growing together with no intermediate forms.

LAGUNCULARIA RACEMOSA (L.) Gaertn. "Bastard buttonwood." Common, especially in the swash. Fresh Creek, June (594).

**Terminalia spinosa** sp. nov. "Brier tree," "Prickly tree"

A low, spreading, flat-topped tree, height about 5 meters, 1.5–2 dm. in diameter; bark lightish, ridged: branches horizontal; branchlets divaricate, spiny: leaves fascicled, subsessile, oblanceolate or spatulate, 1–1.5 cm. long, 4–6 mm. wide, thick, glabrous, yellowish-green below, obtuse or retuse at the apex, tapering into a short petiole at base (1–2 mm.), margin entire, slightly revolute; spines axillary, slender, 3–7 mm. in length, mostly in threes at the end of the branchlets: flowers small, greenish, growing in axillary spikes, the 5–7 flowers approximate, so as to resemble a head; peduncle 6–10 mm.; bracts small, ovate: calyx valvate, tube 1 2.5 mm. long, prolonged beyond the ovary, constricted above it, limb campanulate, subtruncate, 1–2 mm. long, with 5 small teeth, villous within, deciduous, disk of 4 brownish, villous, two-lobed glands at mouth of calyx tube: stamens 8 (9), ex-

serted, about 3 mm. in length, alternate ones inserted lower down on the calyx, filaments slender: anthers cordate: ovary 1-celled: ovules 3, flask-shaped or oblong, suspended from the top of the cell: style simple, equalling or slightly exceeding the stamens, subulate, a little thickened at base, villous: stigma simple: young fruit ovoid. Foliage closely resembling that of *T. angustifolia* but inflorescence very different.

A few monstrous flowers were found like those described by Grisebach as occurring in *Bucida Buceras* L. Collected on the savannas at Red Bays in April and near the source of Fresh Creek in June, no. (502).

PLATE 13. *Terminalia spinosa*. Portion of plant, natural size; *n*, cluster of flowers; *a*, flowers showing disk; *p*, stamen.

BUCERAS CATAPPA (L.) A. S. Hitch. "Almond tree." Nassau, Jan. Cultivated.

MELASTOMACEAE

TETRAZYGIA BICOLOR (Mill.) Cogn. (*T. elaeagnoides* DC.) Common in the pines on both islands. Nassau, Jan.; Conch Sound, May (127). Same as Wright 1222.

ONAGRACEAE

JUSSIAEA SUFFRUTICOSA L. Near Southwest Beach, N. P., Feb. (320). Same as Wr. 159.

SAMYDACEAE

CASEARIA LAETIOIDES (Rich.) Cocoanut Pt., Andros, April (514). Same as Wright 1108.

CASEARIA BAHAMENSIS Urban. Nicol's Town, March, April (384). Distributed as *Thioidia serrata* Endl.

BANARA RETICULATA Gris. Conch Sound, May (558). Same as Wr. 1882. Determined at Kew by Dr. N. L. Britton.

UMBELLIFERAE

HYDROCOTYLE PYGMAEA Wright. Red Bays, Conch Sound, April (499, 524). Determined at Gray herbarium by Mr. J. M. Greenman.

CENTELLA ASIATICA (L.) Urban. (*Hydrocotyle Asiatica* L.) In low ground in the pines. Red Bays, April (494).

ANETHUM GRAVEOLENS L. "Dill-seed." Nicol's Town, April. Escaped (438).

MYRSINACEAE

RAPANIA GUYANENSIS Aubl. (*M. Floridana* A. DC.) Nicol's Town, March (387).

ICACOREA PANICULATA (Nutt.) Sudw. (*Ardisia Pickeringia* T. & G.) "Stopper-tree." New Providence, Jan. (234). Same as Curtiss 1799.

JACQUINIA KEYENSIS Mez. "Joe-bush," "iron wood." Common on the cays and along the eastern shores of both islands. Rose Island, N. P., Feb.; Fresh Creek, June; Mars Bay, July (251). A new species described in Symbolae Antillanae, 1890.

PRIMULACEAE

SAMOLUS EBRACTEATUS Kunth. Common on the savannas at Red Bays, April (478).

PLUMBAGINACEAE

PLUMBAGO SCANDENS L. Common about Nassau, Jan. (11).

SAPOTACEAE

CHRYSOPHYLLUM OLIVIFORME Lam. "Saffron-tree." In the pines on both islands. New Providence, Feb. (262).

BUMELIA CUBENSIS Griseb. London Creek, Andros, May. In fruit only. "Rather small-leaved." Determined by Dr. B. L. Robinson, Gray herbarium (544).

BUMELIA MICROPHYLLA Griseb. In the swash on the west side of Andros. In fruit only. Purser Pt., June (666). Same as Brace 234 and Eggers 4418. Determined by Dr. Britton at Kew.

LUCUMA PAUCIFLORA A. DC. "Egg fruit." Deep Creek, June (703). Same as Wright 346.

SIDEROXYLON MASTICHODENDRON Jacq. In fruit. Cocoanut Pt., Andros, April (450). Same as Wright 1324.

DIPHOLIS SALICIFOLIA A. DC. "Wild cassada," "bustic." Common in the coppet on both islands. Nassau, Feb.; Fresh Creek, June; Deep Creek, July (326). Same as Eggers 4106.

MIMUSOPS DISSECTA R. Br. "Wild sapodilla." Common near the shore on both islands. Hog Island, N. P., Feb. (263).

MIMUSOPS FLORIDANA Engelm. "Wild sapodilla." Conch Sound, May; Deep Creek, July (734). Same as Curtiss 1766. Determined at Kew by Dr. N. L. Britton.

ACHRAS SAPOTA L. "Sapodilla." Common in cultivation. Nassau (42).

EBENACEAE

MABA CARIBAEA (A. DC.) Hiern. (*Macreightia.*) Fresh Creek, June (640). Same as Wright 1331.

OLEACEAE

ADELIA PORULOSA (Poir.) Engler. Savannas back of Red Bays. April (511). Determined by Dr. B. L. Robinson, Gray herbarium.

ADELIA sp. Coppet, Conch Sound, May. Staminate flowers only. Near *A. porulosa*, but leaves are broader, 1.5–2 cm. wide, 5 cm. long, more tapering at the base and apex; veins inconspicuous, not shining above; filaments broader (589).

LOGANIACEAE

SPIGELIA ANTHELMIA L. Mastic Pt., May (599). Same as Wright 390.

CYNOCTONUM MITREOLA (L.) Britton. (*Mitreola petiolata* T. & G.) In savannas on the west side of Andros. Differs from all specimens examined in having the branches of the cymes much more divergent, and the inflorescence scarcely, if at all, unilateral. Red Bays, April (492).

CYNOCTONUM SESSILIFOLIA (T. & G.) Britton. 12–15 cm. in height, strict, leaves rather rigid, 0.5–1 cm. in length, like specimen from East Florida collected by Palmer, no. 436; also like specimen from Key West (573). In savannas on west side of Andros, Red Bays, April.

GENTIANACEAE

EUSTOMA EXALTATUM Griseb. Abundant in the savannas on the west side of Andros; occurs sparingly elsewhere. New Providence, Jan.; Red Bays, April (201, 456).

SABBATIA CAMPANULATA (L.) Torr. (*S. gracilis* Salisb.) Quite common on both islands. On New Providence growing in sand near the shore; on Andros on the savannas near Red Bays and also near fresh water in the interior. Very variable, flowers often white. Hog Island, N. P., Feb.; Red Bays, April; Stafford Creek, May (322, 464, 744).

VOYRIA MEXICANA Griseb. Conch Sound, March (415).

APOCYNACEAE

VINCA ROSEA L. Nassau, Jan. (111).

PLUMIERA OBTUSA L. "Frangipani," "milkweed." Not uncommon near the shore. Fresh Creek, June (651).

ECHITES ANDREWSII Chapm. "Wild unction." Common. Conch Sound, April, May (522).

ECHITES BIFLORA Jacq. Conch Sound. Collected by Mr. Alexander Keith, 1892 (740). Same as Eggers 2676.

ECHITES SAGRAEI A. DC. Common. Nassau, Jan.; Conch Sound, March; Red Bays, April (128, 431, 461).

ECHITES UMBELLATA Jacq. "Devil's potato-root," "dream-vine." Very common and variable; leaves range from lanceolate to orbicular, 2–10 cm. in width. Nassau, Jan.; Conch Sound, March; Red Bays, April; Deep Creek, June (61, 403, 673).

PLUMIERA RUBRA L. "Frangipani," "jessamine tree." Mastic Paint (601).

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THEVETIA THEVETIA (L.) Millsp. Cultivated at Nassau (75).

ASCLEPIADACEAE

ASCLEPIAS CURASSAVICA L. Common about Nassau, Jan. (21).

METASTELMA BAHAMENSE Griseb. Conch Sound, March (410).

**Metastelma barbatum** sp. nov.

Stem smooth, twining: leaves linear or linear-lanceolate, occasionally oblong, 1–2.5 cm. in length, 2–3 mm. in width, apex cuspidate or obtuse and mucronate, occasionally acute, base obtuse, margin entire, slightly thickened, midrib prominulous on the under side; petioles 2–3 mm.: umbels five- to eight-flowered; peduncle 1–1.5 mm.; pedicels about 1 mm.: calyx lobes smooth, ovate, obtuse, about one fourth the length of the corolla: corolla greenish-white, urceolate-campanulate: petals lanceolate-oblong, obtuse, united about one third of the way, the upper third densely villous within and with a few scattered hairs in the center of the petal below, crown segments attached to the base of gynostegium and of the corolla, equalling the column in length, somewhat incurved, ligulate, bifid at the apex, teeth often unequal, rarely obtuse: gynostegium about half as long as the corolla: stigma depressed: follicle slender, acuminate, 3 cm. in length (474).

PLATE 14. *Metastelma barbata.* Portion of plant; *e*, crown; *a*, calyx and pistil; *c*, petals; *h*, part of gynostegium; *p*, pollinia.

A low, twining plant, common on the savannas near Red Bays on the west side of Andros, April 15. The same as a specimen at Kew collected by Governor Robinson in the pine barrens of New Providence, April, 1877.

The species is closely related to *Metastelma Blodgettii* Gray, but differs in having no lines of pubescence on the stem, umbels 5–8-flowered, peduncles and pedicels shorter and the flowers smaller with the calyx shorter in proportion to the corolla, scales of the crown slightly incurved, broader and toothed at the apex.

METASTELMA PALUSTRE Schltr. (*Seutera maritima* Decsn.) Hog Island, N. P., Feb.; Red Bays, April (333, 475).

### CONVOLVULACEAE

IPOMOEA BATATAS Lam. "Sweet potato." Cultivated and escaped on both islands. Nassau, Jan. (77, 223).

IPOMOEA CATHARTICA Poir. Nassau, Jan. (220). Determined by Dr. Britton at Kew.

IPOMOEA COCCINEA L. Nassau, Jan. (120).

IPOMOEA COMMUTATA R. & S. Nassau, Jan. (231).

IPOMOEA FASTIGIATA Sweet. Nicol's Town, April (518). Compared at Kew by Dr. Britton. Same as Eggers 4370, 4541 from Bahama.

IPOMOEA HEPTAPHYLLA Griseb. In the pines. Conch Sound, May (569). Same as Wright 1371.

IPOMOEA JAMAICENSIS Don. "Glory-morning." Common and very variable. Nassau, Feb.; Conch Sound, April; Fresh Creek, June; Mars Bay, July (77, 254, 451, 623, 710). Determined by Dr. Britton at Kew.

IPOMOEA GRANDIFLORA Lam. (*I. longiflora* R. Br.) On sandy beaches. Salt Cay, N. P., Jan.; Deep Creek, June (244).

IPOMOEA PES-CAPRAE (L.) Sweet. "Bay-hop." Very common on sandy shores on both islands. Cocoanut Point, Andros, May (533).

IPOMOEA REPANDA Jacq. (*I. arenaria* Steud.) Common in the pine-yard. Conch Sound, March (394, 404). Same as Wright 3102. No. 394 has the leaves deeply cordate at base.

IPOMOEA SIDIFOLIA Chois. "Christmas gambol," "Christmas-flower." Common about Nassau. Nassau, Jan. (13).

IPOMOEA SINUATA Ort. (*I. dissecta* Pursh.) Common in the coppet on both islands. Nassau, Jan.; Fresh Creek, June (16, 76).

IPOMOEA TRILOBA L. Conch Sound, March; Fresh Creek, June. Leaves 1.5–2 cm. long, plant smaller and more delicate than any specimens examined; closely resembles an unnamed specimen of Blodgett's from Key West, in Torrey herb. (423).

JACQUEMONTIA JAMAICENSIS (Jacq.) Hall. Common on both islands. Nassau, Jan. (135).

JACQUEMONTIA VERTICILLATA (L.) Urban. Conch Sound, March (424). Same as Wright 455.

EVOLVULUS ARBUSCULA Poir. Fresh Creek, June (607). Resembles Wright 1658; differs from Wright 456 in being more slender, not as erect, flowers smaller, 3–4 mm., white; calyx and corolla sericeous; calyx shorter, about 1.5 mm. long. Plant about 6 dm. in height, leaves 1–2 mm. long.

DICHONDRA REPENS Forst. Nassau, Jan. (172). Same as Wright 459.

### CUSCUTACEAE

CUSCUTA AMERICANA L. Growing on shrubs in low ground. Red Bays, April (497). Same as Wright 1659.

### HYDROPHYLLACEAE

NAMA JAMAICENSE L. Nassau, Jan. (166).

### BORAGINACEAE

CORDIA ANGUSTIFOLIA R. & S. Fresh Creek, June (619). Agrees with Wright 3114 except in having spatulate leaves and surface much less pubescent.

CORDIA LIMA R. & S. "Granny-bush." Common on Andros. Nicol's Town, March (376). Ex. desc.

CORDIA SEBESTENA L. Common along shore on both islands. Same as Cooper 52; agrees with Wr. 3554 except in the shape of the leaves. All the Bahaman specimens examined have the leaves oval instead of ovate (107).

BOURRERIA HAVANENSIS (Willd.) Miers. "Strong-back." Common on both islands in the pines and coppet. Nassau, Jan.; London Creek, May; Fresh Creek, June (74, 542).

TOURNEFORTIA GNAPHALODES (Jacq.) R. Br. Common on sandy beaches on both islands. Nassau, Jan. (63).

TOURNEFORTIA VOLUBILIS L. Nassau, Jan.; common on both islands (212).

HELIOTROPIUM CURASSAVICUM L. Nassau, Jan.; Middle Bight, Andros, June (198).

HELIOTROPIUM PARVIFLORUM L. Nassau, Jan. (24).

**Heliotropium nanum** sp. nov.

Low, shrubby, corymbose-branching, 8–11 cm. high, branches erect-ascending, entire plant strigose-canescent: leaves numerous, appressed, alternate, sessile, about 2 mm. long and 1 mm. wide, elliptical-oblong in shape, acute, margin entire: flowers scattered, solitary, sessile, about as long as the leaves and opposite them: calyx persistent, segments 5, imbricate, slightly unequal, lanceolate, acute, about 1 mm. in length, strigose-canescent: corolla white, campanulate, shortly exceeding the calyx, hairy on the outside, lobes 5, ovate-oblong: stamens inserted about the middle of the corolla tube; anthers lanceolate, appendiculate appendage almost as long as the anther; disk flat: ovary free, globose: style short: stigma annular with a conical tip: fruit depressed-globose, separating into four one-seeded, hairy nutlets: seeds curved (757).

Collected at Red Bays on the savannas. In flat, rather marly ground near the shore.

VERBENACEAE

LANTANA CAMARA L. Not uncommon. Nassau, Jan.; Red Bays, April (129, 490).

LANTANA CROCEA Jacq. Nicol's Town, March; Conch Sound, May (352, 561). 352 has larger leaves, 3.5–4.5 cm. in length, and shorter peduncles (1.5–2 cm.) and may be *L. polyacantha* Schauer, as it much resembles a specimen collected by Eggers at St. Thomas and so named by Watson.

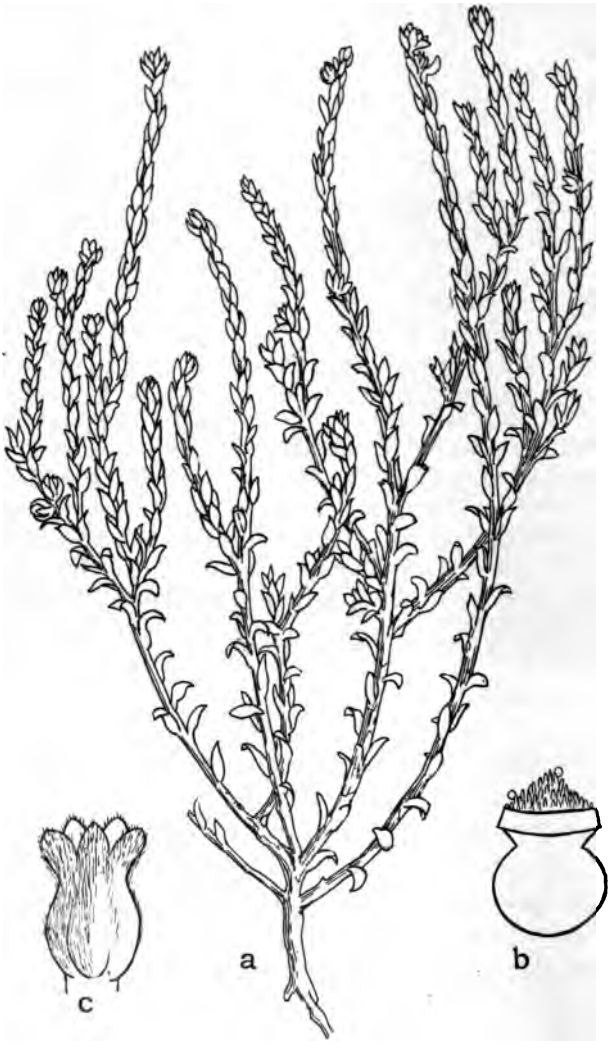
LANTANA INVOLUCRATA L. "Wild sage," "big sage." Common on both islands. Fort Montague, Nassau, Jan. (56).

LIPPIA CANESCENS Kth. Nassau, Jan. (114).

LIPPIA NODIFLORA (L.) Michx. Hog Island, N. P.; Red Bays, April (250, 481). Same as Eggers 1537, St. Domingo (unnamed).

ABENA JAMAICENSIS (L.) A. S. Hitch. (*Stachytarpha* Vahl.) Roadsides, Nassau, Jan. (19).

CITHAREXYLUM BERTERII Spreng. Calabash Cay, Andros, June (608). Leaves much longer than in Wright (1356), 10–12 cm. long, 1–2.5 cm. wide.




*Heliotropium nanum.* *a*, Plant × ⅔; *b*, ovary; *c*, calyx.

CITHAREXYLUM LUCIDUM Cham. & Schlecht. Leaves oblanceolate, cuneate at base shining and leathery when old, apex obtuse or emarginate, corolla puberulous, raceme erect in fruit. Conch Sound, May (571).

DURANTA REPENS L. (*D. Plumieri* Jacq.) Common on both islands. Nassau, Jan. (39).

PETITIA DOMINGENSIS Jacq. Nicol's Town, March (358). Compared at Kew by Dr. Britton. Same as Eggers 4203 and Robinson 55.

VITEX ILICIFOLIA Rich. Fresh Creek, June (625). Determined at Kew by Dr. Britton. Same as Wright 3180.

AVICENNIA NITIDA Jacq. "Salt bush," "black mangrove." Common in the swash and along the shore. Mastic Point, May (593).

OVIEDA FRAGRANS (W.) A. S. Hitch. (*Clerodendron*). "Wild jessamine." New Providence, along the roadside. Naturalized. Feb. (328).

OVIEDA ACULEATA (L.) A. S. Hitch. Nassau, March. Escaped? (296).

LABIATAE

MICROMERIA BROWNEI Benth. Conch Sound, April (526). Petioles 4–5 mm., equalling or exceeding the leaves and peduncles: under surface of leaves and stem purplish.

SALVIA OCCIDENTALIS Sw. New Providence, Feb. (265).

SALVIA SEROTINA L. Silver Cay, Nassau, Jan. (157).

LEONURUS SIBIRICUS L. Common about Nassau, Jan. (2).

LEONOTIS NEPETAEFOLIA (L.) R. Br. Nassau, Jan. (31).

TEUCRIUM CUBENSE L. Nassau, Jan. (108).

MESOSPHAERUM PECTINATUM (Poit.) Kuntze. Red Bays, Andros, April (505).

SOLANACEAE

SOLANUM ACULEATISSIMUM Jacq. Nassau, Jan.; Fresh Creek, June.

SOLANUM BAHAMENSE L. "Cankerberry." Common on both islands. Variable. Nassau, Jan.; Salt Cay, Jan. (174, 241). 174 has prickles on both veins and midrib of the leaves as well as on the stems while 241 is entirely unarmed and has racemes 10–12 cm. long, recurved at the apex.

SOLANUM NIGRUM L. Nassau, Jan. (126, 228).

SOLANUM NIGRUM NODIFLORUM Gray. Conch Sound, May; Fresh Creek, June (557, 614).

SOLANUM VERBASCIFOLIUM L. "Salve-bush." Common on both islands. Nassau, Jan. (131).

PHYSALIS ANGULATA L. Fresh Creek, June (616).

PHYSALIS BARBADENSIS Jacq. Conch Sound, March (421).

CAPSICUM BACCATUM L. "Bird-pepper." Hog Island, N. P., Feb. (256).

CESTRUM PALLIDUM Lam. Nicol's Town, April (432).

DATURA METEL L. Deep Creek, June. Probably escaped (700).

SCROPHULARIACEAE

ANTIRRHINUM ANTIRRHINIFLORA (Willd.) A. S. Hitch. (*A. maurandioides* Gray.) Nassau, Jan. Probably escaped (95).

RUSSELIA JUNCEA Zucc. Escaped. Nassau, Jan. (122).

STEMODIA MARITIMA L. Nassau, Jan. (265).

CAPRARIA BIFLORA L. Common on both islands. Nicol's Town, March (27, 381).

BUCHNERA ELONGATA Sw. Common on savannas on the west side of Andros. Red Bays, April (467).

GERARDIA MARITIMA Raf. Common on savannas on west side of Andros. Red Bays, April; Purser Point, June. Variable (751).

GERARDIA PURPUREA L. 4–4.5 dm. in height, mostly simple and strict. Red Bays, April (459).

LENTIBULARIACEAE

UTRICULARIA FOLIOSA L. Stafford Creek, Andros, May. "No certain determination possible without flowers: the bladders appear like those of *U. foliosa* which is common in the West Indies." Dr. Thomas Morong (543, 547).

UTRICULARIA GIBBA L. Stafford Creek, Andros, May. No flowers. "Leaves and bladders much resemble those of *U. gibba*, which occur in Florida." Dr. Thomas Morong (548).

PINGUICULA PUMILA Michx. Rare; on the edge of the swash on the west side of Andros. Red Bays, May (572).

BIGNONIACEAE

TECOMA LEPIDOPHYLLA Griseb. Purser Point, Andros, June (660). Same as Wright 1341.

TECOMA sp.

Medium-sized shrub, twigs rusty-lepidote: leaves digitate, with three or five leaflets; petioles 1–2 cm. long, channelled above, spar-

ingly rusty-lepidote; petiolules 2.5 mm. long, central, one half as long again as the lateral: leaflets 2.5–4.5 cm. long, 1.5–2.5 cm. broad, obovate or oval, retuse or emarginate and mucronate at apex, obtuse and usually unequal at base, margin crenulate; veins prominent below: leaves thick, sparingly lepidote above: scales abundant beneath, the larger ones rusty, giving the under surface a slightly brownish tint: flowers not seen: calyx bilabiate, rusty-lepidote, at length deciduous, 7–10 mm. in length; lobes acute: capsule linear, pointed, subcompressed, 6–9 cm. long, rusty-lepidote: valves slightly keeled.

Collected at Long Ridge Cay, Andros, June 20 (758).

**Tecoma Bahamensis** sp. nov. "Beef-bush"

A tall shrub, twigs light brown, lepidote: leaves opposite, palmately compound, with five leaflets; petioles 3–5 cm. in length, flattened and channelled above; leaflets all petiolulate; petiolule of the central leaflet about 1 cm. in length, being slightly longer than those of the lateral leaflets and more than twice as long as those of the basal leaflets: leaflets oblong or oblong-elliptical, sometimes oblanceolate, 2–4 cm. long, 1–2.5 cm. wide, the central leaflet largest, thickish, apex obtuse or retuse, margin entire or slightly undulate, veins prominulous beneath, 4–7 pairs diverging from the midrib at nearly right angles, surface lepidote on both sides, pale green above, white beneath owing to the confluent white scales: inflorescence terminal, sessile, many-flowered cymes: flowers showy, pale pink; pedicels rusty-lepidote, about 1 cm. in length: calyx rusty, campanulate, closed in the bud, about 1.5 cm. in length, bilabiate, lower lip subtruncate, upper longer, usually rounded: corolla funnel-shaped, veiny, pink, about four times as long as the calyx; limb spreading; lobes rounded, slightly unequal, margin sometimes undulate, tube pubescent within: stamens 4, didynamous, less than half the length of the corolla, inserted near the base of the tube; filaments incurved; anther cells linear-oblong, divaricate, straight: pistil about 2.5 cm. in length: ovary lepidote, two-celled: style slender: stigma two-lamellate, lamellae cuneate or obovate; disk pulvinate: capsule elongated, linear, about 8 cm. in length and 7–8 mm. in width, slightly compressed, rusty-lepidote, valves coriaceous, subcarinate, veiny: seeds oblong, slightly notched below, about as long as the striate hyaline wing (218).

Collected on New Providence, near Nassau, Jan. 26; in the interior of the island, Feb. 26, and at Nicol's Town, Andros, March 26.

Note from Kew, 1899: "This matches a plant collected in

the Bahamas by Brace no. 643 and Eggers no. 3962 which has been called *Tabebuia leucoxyla* DC. but according to Bureau *T. leucoxyla* is identical with *T. obtusifolia* Bureau, a totally different plant with simple leaves." Also resembles a specimen at Cambridge from the Bahamas 1859 marked *T. leucoxyla*? by Gray.

PLATE 15. *Tecoma Bahamensis.* Portion of plant in flower, × ¾.

TECOMA STANS (L.) Juss. "Yellow elder." Common about Nassau, Jan. (8).

JACARANDA BAHAMENSIS R. Br. "Boxwood," "cancer tree." Deep Creek, June (701). Determined at Kew by Dr. Britton.

JACARANDA COERULEA Griseb. Nassau, Jan. (213). Same as Eggers 4427.

ACANTHACEAE

THUNBERGIA FRAGRANS Roxb. Probably escaped. Nassau, Jan. (130).

BLECHUM BROWNEI Juss. Nassau, Jan. (49).

ANTHACANTHUS ACICULARIS (Sw.) Nees. Common in the coppet on Andros. Nicol's Town, April; Fresh Creek, June (396). The same as a specimen of Cooper's from New Providence.

DICLIPTERA ASSURGENS Juss. Nassau, Jan. (72).

RUBIACEAE

EXOSTEMMA CARIBAEUM (Jacq.) R. & S. "Princewood." Kemp Sound, Andros, June (685). Same as Wright 2674 and Curtiss 1132.

RHACICALLIS AMERICANA (Jacq.) A. S. Hitch. (*R. rupestris* DC.) "Sand-fly bush," "salt-water bush," "seaweed," "wild thyme." Common along the rocky shores of both islands. Red Bays, April; Fresh Creek, June (458). Same as Wright 2696.

HAMELIA PATENS Jacq. Nassau, Jan. (40). Same as Curtiss 5500 from Florida.

CATESBAEA SPINOSA L. "Prickly apple." Fresh Creek, June (624).

**Catesbaea fasciculata** sp. nov.

A low, spiny shrub with long, slender branches; leaves fascicled, obovate or oblanceolate, 5.7 mm. in length, 3–4 mm. in width, obtuse, tapering into a short petiole at base, thick, shining above, margin entire or slightly revolute, surface of the stem, spines and upper surface of leaves minutely papillose: spines axil-

lary slender, in pairs, about as long as the leaves: flowers scattered, small, solitary, sessile in the axils: calyx-tube short, ovoid; lobes 4, subulate, persistent: corolla valvate, campanulate, white, 5–7 mm. in length; lobes 4, short, 1–2 mm. long, obtuse, spreading: stamens 4, inserted at the base of the corolla tube; filaments glabrous, slightly exceeding the tube; anthers linear: ovary 2-celled, 2-flattened, pendulous ovules in each cell: style smooth, a little longer than the stamens: fruit (immature) a berry.

Collected at Fresh Creek, Andros, June 6. The same as Eggers 4508 from Hog Island (627).

PLATE 16. *Catesbaea fasciculata*. Portion of plant, about natural size; *o*, flower with corolla removed; *n*, interior of corolla showing stamens.

SCOLOSANTHUS sp.

A low, tortuous branching shrub, slightly resinous with slender scattered spines, 5–6 mm. in length: leaves and stem minutely papillose: leaves fascicled or opposite, minute, 2–2.5 mm. in length, short-petioled, ovate, obtuse with revolute margins, thick, shining: stipules small, connate: flowers not seen: drupe ovoid or globose, sessile, axillary, white, about 2 mm. in length, and containing one compressed seed.

A single specimen collected on the south side of Fresh Creek, Andros, June (646).

RANDIA ACULEATA L. Common on both islands. Nicol's Town, March (383). Same as Wright 392 and Curtiss 1129.

GENIPA CLUSIAEFOLIA (Jacq.) Griseb. "Seven-year apple." Spruce Cay, N. P., Feb.; Mastic Pt., Fresh Creek, June (299). Same as Wright 3574 and Curtiss 1130.

GUETTARDA ELLIPTICA Sw. Stafford Creek, Andros, May; Lisbon Creek, June (540, 677).

GUETTARDA SCABRA Lam. Stafford Creek, May; Fresh Creek, June; Conch Sound, July (535, 649, 730). The specimens from Stafford and Fresh Creek 535 and 649 are identical but differ greatly from 730; the former have thicker, rigid leaves, paler in color, with an entire revolute margin and the veins prominently raised on the under surface. No. 730 has the leaves strongly mucronate, margin crenate and the upper surface much more scabrous than in Wright 2707. No. 730 is the same as Brace 186 and 197 as compared at Kew by Dr. Britton.

ANTIRRHOEA LUCIDA Gaertn. Deep Creek, July (724). Same as Wright 1270.

ANTIRRHOEA MYRTIFOLIA Griseb. Red Bays, April; Fresh Creek, June (470). Same as Wright 2782 and Brace 445. Determined at Kew by Dr. Britton.

ERITHALIS FRUTICOSA L. "Black torch." Common on both islands. Nicol's Town, March; Red Bays, April; Deep Creek, June (365, 482, 691). Same as Curtiss 1127.

ERITHALIS ROTUNDATA Griseb. Deep Creek, June (739). Same as Wright 1268.

CHIOCOCCA PARVIFOLIA Wulschl. "Snake-root." Common in the coppet on both islands. Nassau, Jan.; Deep Creek, June (138, 688). Same as Wright 3584.

CHIOCOCCA ALBA (L.) A. S. Hitch. (*C. racemosa* Jacq.) Nassau, Jan. (28).

CHIOCOCCA sp. Red Bays, April (477).

The latter was a depressed form found in the savannas on the west side of Andros. Stems erect, unbranched; plant low, about 3 dm. in height, with smaller, thicker, more rigid leaves, lanceolate with a blunt apex, 2–2.5 cm. long; flowers yellowish-brown. Resembles a specimen of Blodgett's from Key West in the Gray herbarium.

PHIALANTHUS MYRTILLOIDES Griseb. "Candle-wood." Stafford Creek, May; Fresh Creek, June (541, 642, 728).

STRUMPFIA MARITIMA Jacq. Common on the cays and along the shores of both islands. Nassau, Jan.; Lisbon Creek, Andros, June (151).

MORINDA ROYOC L. "Wild mulberry," "wild pineapple." Not uncommon in the pines on Andros. Conch Sound, March (425). Same as Wright 2757. Plants 1.5–2 m. in height.

MYRSTIPHYLLUM PUBESCENS (Sw.) A. S. Hitch. (*Psychotria.*) Conch Sound, May (585). Same as Wright 243 and 1278.

MYRSTIPHYLLUM UNDATUM (Jacq.) A. S. Hitch. (*Psychotria.*) "Wild coffee." Nicol's Town, March (361).

### **Myrstiphyllum ligustrifolium** sp. nov.

A low shrub with smooth dark bark: branchlets slightly angled: leaves opposite; petioles 2–4 mm. in length; blade elliptical or oblanceolate, 3–6 cm. long, 1–2 cm. broad, thickish, paler beneath, apex acuminate, base cuneate or tapering, margin entire, slightly revolute, glabrous or with a few scattered hairs beneath

on the midrib or in the axils of the veins, veins rather inconspicuous above: stipules rusty membranaceous, truncate, sheath deciduous, about 5 mm. in length: flowers in three- to five-rayed terminal panicles; peduncle about 2 cm. in length; pedicels about 1 mm. or flowers sessile; bracts minute, ciliate: calyx deciduous, tubular-campanulate, 1–2 mm. long; lobes 5, very short, acute, ciliate: corolla whitish, somewhat funnel-form, about three times as long as the calyx, throat bearded, lobes 5, valvate, half as long as the tube, lance-oblong, obtuse, thickened and involute at the apex, at length reflexed: stamens 5 (6), inserted in the throat of the corolla, included; filaments short; anthers oblong: ovary two-celled, globose.: style smooth, dilated upwards, two-cleft at apex: drupe dark red, globose or ovoid, 5–6 mm. high, 4–5 mm. broad, pyrenae flat, four-furrowed, crests broadly obtuse (206).

Collected at two places in the neighborhood of Nassau, Jan. The same as Eggers 4052 from Hog Island. It is related to *M. celastroides* Gris.

PLATE 17. *Myrstiphyllum ligustrifolium*. Branch in leaf and flower, about natural size; *h*, fruiting branch; *s*, single flower; *a*, interior of corolla showing stamens; *c*, pistil.

ERNODEA LITTORALIS Sw. Common in the pines on both islands (sometimes near the shore). Flowers red or white. New Providence, Jan.; Rose Island, N. P., Feb.; Nicol's Town, March (102, 264).

SPERMACOCE TENUIOR Lam. In the pines, N. P., Feb. (319). Same as Eggers 4441.

RELBUNIUM HYPOCARPIUM (L). Hemsl. (*Galium hypocarpium* Endl.) Conch Sound, April (523). Plants glabrous.

### CUCURBITACEAE

**Anguria Keithii** sp. nov.

Stem climbing, glabrescent, somewhat sulcate: leaves deeply divided with seven narrowly elliptical segments, 4–6.5 cm. long, .5–1 cm. wide, outside segments lobed near the base: central segments the narrowest, apex mucronate, tapering at base, margin entire above but the three or five central segments with a few, large mucronate teeth (one to five on each side): petiole .5–2 cm.: leaves rather thin, somewhat punctate beneath: tendrils simple, much longer than the leaves: inflorescence racemose, the 3–6 flowers approximate at the top of the peduncle; peduncle about 8 cm. long, longer than the leaves; pedicels 5–9 mm. long: staminate flowers: calyx tubular-campanulate, constricted at the throat; tube

5–7 mm. long; lobes 5, 2–3 mm. long, lanceolate, acuminate: petals orange, elliptical, about 1 cm. in length, obtuse or shortly mucronate: stamens 2, included; anthers inserted about the middle of the tube, sessile, lanceolate, acuminate or acute, about 6 mm. in length, replicate below about one third of the way: pistillate flowers and fruit not seen (556).

Collected at Conch Sound, Andros, May 8. Comes nearest to *A. pedata* Jacq. but differs in having leaves 7-cleft, segments narrower, margin more deeply toothed and leaves thinner, flowers fewer, sepals longer and acuminate.

Named for Mr. Alexander Keith on whose sisal plantation the plant was collected.

PLATE 18. *Anguria Keithii.* Portion of vine, × ⅔; *a*, stamen, front view; *n*, stamen, rear view.

TRIANOSPERMA RACEMOSA (Griseb.) T. & G. Conch Sound, March (419). Same as Wright 1243.

GOODENIACEAE

SCAEVOLA PLUMIERI (L.) Vahl. Common on the sandy beaches on both islands. South Beach, N. P., Jan. (85).

COMPOSITAE

VERNONIA BAHAMENSIS Griseb. Common in the pines on both islands. Nassau, Jan. (101). Same as Eggers 4187 and Brace 118.

AGERATUM CONYZOIDES L. Nassau, Jan. (22).

EUPATORIUM AGERATIFOLIUM DC. Nassau, Jan. (176). Same as Wright 2803.

**Eupatorium Bahamense** sp. nov.

Shrubby, branching, branches cylindrical, striate, tips pubescent, somewhat rusty: leaves opposite; petioles 3–10 mm. in length, lanceolate or ovate-lanceolate, 2–4.5 cm. long, .75–2 cm. wide, base cuneate, apex obtuse, margin entire or slightly repand, triply nerved (in some young leaves obscurely so), the lateral nerves usually starting 2–5 mm. above the base, glabrous above, glabrate and densely dotted with glands beneath, glands mostly black: corymbs numerous, trichotomous; peduncles with a few scattered glands; heads shortly pedicellate, often in pairs; pedicels 2–6 mm. in length, ten- to thirteen-flowered: flowers blue; receptacle cylindrical, flat on top: involucre cylindrical, 8–10 mm. long, about 2 mm. broad; scales imbricate in about four rows, innermost

linear-lanceolate, about 6 mm. in length, outer lanceolate or oblong-lanceolate, apex rounded, sometimes somewhat spatulate, the outer somewhat thickened at the top and darker, mostly three-striate, inner scales sometimes slightly toothed near the base: corolla light blue, clavate, 3–4 mm. long, teeth less than 1 mm.: pappus white, spreading, about as long as the corolla: achenia black, tapering at the base, three-, four- or five-angled, mostly three, with the other angles obsolete, angles scabrous (359).

Collected in the coppet at Nicol's Town, March 17. Not uncommon. Same as Eggers 4424 and Brace 225.

Related to *E. conyzoides* Vahl, but differs in having the leaves and branches less divaricate, leaves obtuse, involucral scales tapering at the apex, heads fewer flowered and achenia often 3–4-angled.

PLATE 19. *Eupatorium Bahamense.* Portion of plant, × ⅔; *a*, head of flowers.

EUPATORIUM CAPILLIFOLIUM (Lam.) Small. (*E. foeniculaceum* Willd.) Hog Island, N. P., Feb. (252).

EUPATORIUM ODORATUM L. Nassau, Jan. (6). Same as Wright 295.

EUPATORIUM VILLOSUM Sw. Common and variable. Nassau, Nicol's Town, March, Conch Sound, April (307, 340, 563). No. 307 from Nassau, and 563 from Conch Sound are almost entirely glabrous forms.

WILLUGBAEYA SCANDENS (L.) Kuntze. (*Mikania Orinocensis* H.B.K.) Not uncommon in wet places. Hog Island, Feb.; Conch Sound, May (245). Same as Wright 3600.

ASTER EXILIS Ell. In damp places. Hog Island, N. P., Feb.; Conch Sound, April; Fresh Creek, June (246, 650).

BACCHARIS DIOICA Vahl. "Broom-bush." Common near the shore. Nassau, Jan. (68).

ERIGERON QUERCIFOLIUM Lam. In the pines. New Providence, Feb.; Nicol's Town, March (324, 360).

PLUCHEA FOETIDA (L.) B.S.P. Damp ground in the pines. Red Bays, April (498). Same as Eggers 4103.

PLUCHEA CAMPHORATA DC. Banana holes in the pines. N. P., Feb. (317).

PLUCHEA ODORATA (L.) Cass. "Cough-bush." New Providence, Feb.; Nicol's Town, March (283).

PARTHENIUM HYSTEROPHORUS L. Nassau, Jan. (1).

IVA CHEIRANTHIFOLIA Kth. New Providence, Feb. (311). Same as Eggers 4286.

IVA IMBRICATA Walt. Common on sandy shores. Deep Creek, July (716).

AMBROSIA HISPIDA Pursh. "Bay lavender," "sweet bay." Common on sandy beaches of both islands. Nassau, Jan.; Mastic Point, May (62).

ISOCARPHA OPPOSITIFOLIA R. Br. "Boston catnip." Deep Creek, June (681). Determined at Kew by Dr. Britton.

BORRICHIA ARBORESCENS DC. Common on both islands. Glabrate and canescent forms found growing together in several localities. Nassau, Jan. (90). Canescent form the same as Eggers 1609, the glabrous the same as Wright 2899.

AMELLUS ASPERA (Jacq.) Kuntze. (*Melanthera deltoidea* Rich.) Common on both islands. Nassau, Jan.; Red Bays, April (58, 503).

SALMEA PETROBIOIDES Griseb. Nassau, Feb. Common along shore (303).

BIDENS LEUCANTHA Willd. "Shepherd's needle." Nassau, Jan. (36).

TRIDAX PROCUMBENS L. Nassau, Jan. (25).

FLAVERIA LINEARIS Lag. Red Bays, April (462). Same as Wright 2859.

POROPHYLLUM RUDERALE Cass. Lisbon Creek, Andros, June (675).

PECTIS LINIFOLIA L. "Tea-blinkin." Nassau, Jan. (200).

NEUROLAENA LOBATA (L.) R. Br. Red Bays, April (486).

ERECHTHITES HIERACIFOLIA (L.) Raf. Red Bays, April (504).

EMILIA SONCHIFOLIA (L.) DC. Nassau, Jan. (3, 5).

ANASTRAPHIA NORTHROPIANA Greenman. "Candlewood." Fresh Creek, June (743). Differs from the following species in having the "leaves mostly entire, scales of the involucre more numerous and strongly revolute." Named at Gray herbarium by Mr. J. M. Greenman, 1897. Same as Combs no. 521 from Cuba, 1895.

ANASTRAPHIA PAUCIFLOSCULOSA Wright. "Candlewood." Lisbon Creek, June. Same as Eggers 3866. Determined at Kew by Dr. Britton (639).

CHAPTALIA ALBICANS (DC.). Conch Sound, March (400). Same as Wright 2873.

SONCHUS OLERACEUS L. Nassau, Jan. (48).

## RELATIONS OF THE BAHAMA FLORA

Professor Hitchcock has treated this subject very fully in his Report on the Plants collected in the Bahamas, Jamaica, and Grand Cayman. It is only taken up here because the exploration of Andros has furnished additional data. In this connection it may be well to describe briefly the character and position of the Bahama Islands in relation to the Greater Antilles and North and South America. "The Bahamas naturally divide themselves first, into sunken banks like the Navidad, Silver and Mouchoir Banks; next islands occupying the whole or nearly the whole summit of the banks from which they rise, like Watlings, Rum Cay, Conception, Samana, Mariguana, the Plana Cays, Inagua, Little Inagua and the atoll of Hogsty; then banks having the semblance of atolls, like the Crooked Island and Caicos Banks, which are fringed by low islands forming a crescent with an open lagoon or flat between its horns; next Salt Cay Bank, which from its structure holds a position intermediate between the group of sunken banks like the Navidad and that resembling Caicos Bank and finally such composite banks as the Little Bahama and Great Bahama Banks with the characteristics of a combination of banks resembling all the others." *

The Little Bahama Bank, lying in 26° to 27° north latitude, is the most northerly. From it rise the islands of Great Bahama and Abaco with a number of small cays. The Little Bahama Bank is separated from the Great Bahama Bank lying south of it by the Northeast and Northwest Providence Channels, which are from twenty to thirty miles wide and have a depth of from five hundred to two thousand fathoms.

"The Great Bahama Bank is irregularly V-shaped and has an extent of four hundred miles from northwest to southeast and is about two hundred and fifty miles in its greatest width."*

The water on the bank is usually only three or four fathoms

* A Reconnoissance of the Bahamas and of the elevated Reefs of Cuba in the steam yacht "Wild Duck," January to April, 1893. Alexander Agassiz.

deep, but it is indented on the north by a tongue of the ocean which extends nearly two thirds across it and has a depth of from seven hundred to twelve hundred fathoms. Along the western edge of this tongue of ocean lies Andros, while New Providence is on the eastern side, twenty-five miles or more distant. On the eastern border of Great Bahama Bank lie the long narrow islands known as Eleuthera, Cat Island, Exuma and Long Island, the first two being separated from the third by another indentation in the bank from the south known as Exuma Sound. To the southeast of Cat Island are the isolated islands of Rum Cay and San Salvador, or Watlings Island, while east of the southern end of the Great Bahama Bank is the much smaller bank on which are situated Crooked, Acklin and Fortune Islands. Still farther southeast lie Mariguana, the Caicos bank and islands and Turks islands, while the entirely isolated island of Inagua is off to the west. Inagua lies in a latitude of about 21° and is the most southerly of the Bahamas. It is about fifty miles from the east end of Cuba and about sixty miles north of the western end of Haiti. From both islands it is separated by water over fifteen hundred fathoms in depth.

The little Bahama bank is separated from Florida by a distance of fifty miles and a depth of less than 450 fathoms of water. The Great Bahama Bank extends west and northwest of Andros for a distance of from fifty to seventy miles. At its western edge it is only forty miles distant from Florida and the channel is about 450 to 500 fathoms deep.

The Great Bahama Bank is separated from Cuba on the south by the Old Bahama Channel, about 300 fathoms in depth, the narrowest part of which is about twelve miles. Beyond this point the water deepens rapidly to 500 and 1,000 fathoms.

The following is quoted from Professor Hitchcock's admirable account: "If from any cause, the depth of the water of the ocean should be lessened by 100 fathoms, there would be exposed the Little Bahama and Great Bahama banks and several of the smaller banks to the southeast. The Bahamas would be separated from the surrounding islands and from Florida and the important channels would still occupy the same places. If reduced by 300 fathoms, the Great Bahama bank would be united with Cuba. If

the water were 500 fathoms shallower than at present, the Little and Great Bahama banks would be united with Florida and some of the Windward Islands would be connected. It is not, however, until a layer of water 1,000 fathoms deep is removed that important changes would occur. Jamaica would be united with Honduras, Cuba with Florida and also with South America through the Windward Islands. There would be a narrow channel between Cuba and Yucatan, between Jamaica and Haiti and a wide and deep channel between Jamaica and Cuba. Watlings, the Acklin Island group and Inagua would still be isolated and the distances between them and the neighboring land would not be materially diminished. * * * The Greater Antilles are of ancient formation and may have been connected with Mexico and Central America at some remote period. But the Bahamas, the Windward Islands and the southern extremity of Florida are of recent origin."

Professor Hitchcock thinks, however, as seems most probable, that the ordinary methods of dissemination are sufficient to account for the Bahaman flora and that the theory of an ancient land connection is not necessary.

The following table shows the distribution of the plants collected by us on New Providence and Andros and bears out the conclusion arrived at by Hitchcock and others that the bulk of the Bahaman plants have come from the south.

Although Andros is very nearly as close to Florida as it is to Cuba, its plants are most closely allied with those of Cuba, comparatively few species, apparently, having come from the north. Our exploration of Andros, however, has shown that this northern contingent is considerably larger than was supposed, a distinct colony of northern plants having found a foothold on the west side of Andros. Many of these have never been reported from either Cuba or any of the other islands of the group.

It was to be expected that the majority of the Bahaman plants would have a southern origin, on account of the greater similarity of the climate and because the prevailing winds and currents are from that direction. There are occasionally heavy "northers" during the winter, when the wind blows hard from the northwest for a number of days at a time. The velocity of the Gulf Stream

as it flows through the Florida Straits tends to prevent seeds being brought from the north by water.

In compiling the table found below, giving the distribution of the plants, collected by us, the following volumes have been the principal ones consulted: Grisebach's Flora of the British West Indies, Grisebach's Catalogus Plantarum Cubensium, Plants collected in the Bahamas by Hitchcock, Plants collected in the District of Cienfuegos, Cuba, by Robert Combs, 1895; Jamaica, List of Fawcett; Flora of St. Croix and the Virgin Islands, Eggers; Chapman's Flora of the Southern United States and other works on the North American flora.

## TABULATED DISTRIBUTION

| Name of Species. | New Providence | Andros. | Cuba. | S. Fla. | S. U. S. | |
|---|---|---|---|---|---|---|
| SCHIZAEACEAE. | | | | | | |
| Ornithopteris adiantifolia L.) Bernh. | + | + | + | + | | 1, 3, 4, 5. |
| " cicutaria Kunze Underw. | + | | | | | 6. |
| POLYPODIACEAE. | | | | | | |
| Tectaria trifoliata (L.) Cav. | | + | + | + | | 1, 3, 4, 5, |
| Dryopteris patens (Swz.) Kuntz. | + | + | + | + | + | 1, 2, 3, 4, 5, widely dis. |
| " asplenioides Bak.) Kuntze. | | + | + | | | 1, 3, 4, 5. |
| Davallia clavata Sw. | + | + | + | | | 1, 3. |
| Asplenium dentatum L. | + | | + | + | + | 1, 3, 4. |
| Blechnum serrulatum Rich. | + | | + | + | | 3, 4, 5. |
| Adiantum tenerum Sw. | + | + | + | + | | 1, 2, 3, 4, 5. |
| Pteridium caudatum (L.) Maxon. | + | + | + | + | + | 1, 4, 5. |
| Pteris longifolia L. | + | + | + | + | | Widely distributed. |
| Vittaria lineata (L.) J. E. Smith. | | + | + | + | | 1, 3, 4, 5, widely dis. |
| Cheilogramma lanceolata (L.) Blume | | + | + | + | | 1, 2, 3. |
| Acrostichum aureum L. | | + | + | + | | Widely distributed. |
| Phlebodium aureum (L.) R. Br. | + | + | + | + | | 1, 2, 4, 5. |
| Polypodium polypodioides (L.) Hitch. | | + | + | + | + | Widely distributed. |
| Campyloneuron Phyllitidis (L.) Presl. | | + | + | + | | 1, 2, 3, 4, 5. |
| Polypodium squamatum L. | | + | | | | 1. |
| Phymatodes Swartzii Baker) Underw. | | + | + | + | | 1, 3, |
| Goniopteris reptans (Swz.) Fée. | | + | + | | | 1, 4, 5. |
| " " cordata. | | + | + | | | |
| PSILOTACEAE. | | | | | | |
| Psilotum nudum L. Griseb. | | + | + | + | + | Widely distributed. |
| CYCADACEAE. | | | | | | |
| Zamia sp. | | + | + | + | | 1, 6. |
| CONIFERAE. | | | | | | |
| Pinus Bahamensis Griseb. | + | + | | | | |
| Juniperus Barbadensis L. | + | + | | + | + | 1, 3. |
| NAIADACEAE. | | | | | | |
| Ruppia maritima L. | | + | + | + | + | Widely distributed. |
| TYPHACEAE. | | | | | | |
| Typha Domingensis Pers. | | + | + | | | 1, 2, 4, 5. |
| GRAMINEAE. | | | | | | |
| Paspalum fimbriatum H.B.K. | + | | | | | 1, 3, 5. |
| Panicum divaricatum L. | + | + | + | + | | Eleuthera, Cat, Crooked, 3, 5. |
| " proliferum Lam. | | + | + | + | + | |
| Cenchrus tribuloides L. | + | + | | + | + | Widely distributed. Crooked, Inagua, 1. |
| Sporobolus Virginicus Kth. | | + | + | + | + | Widely distributed. Crooked, Inagua. |

NOTE.—1 Jamaica 2, Virgin Islands; 3, Windward Islands; 4, Mexico and Central America 5, South America; 6, Haiti. When a plant is reported from all the preceding localities (or all but Haiti) and also as being found in the Eastern Hemisphere, it is marked " Widely distributed."

| Names of Species. | N. P. | Andros. | Cuba. | S. Fla. | S. U. S. | |
|---|---|---|---|---|---|---|
| GRAMINEAE.—*Continued.* | | | | | | |
| Stenotaphrum Americanum Schrank. | + | + | + | + | + | Widely distributed. |
| Chloris Swartziana Doell. | | + | + | + | + | 1, 4, 5. |
| Chaetochloa glauca (L.) Scribn. | + | + | + | + | + | Widely distributed. |
| | | | | | | Inagua, Eleuthera. |
| Eragrostis ciliaris (L.) Link. | + | | + | + | + | Widely distributed. |
| | | | | | | Eleuthera, Cat, Inagua, 5. |
| Uniola paniculata L. | + | | + | + | + | Eleuthera, Cat, Crooked, 4, 5. |
| CYPERACEAE. | | | | | | |
| Cyperus brunneus Sw. | + | + | + | + | + | Eleuthera, Cat, Crooked Inagua, 1, 2, 3, 4. |
| " ferax Rich. | + | | + | | | 1, 3, 4, 5. |
| " ochraceus Vahl. | + | | + | | | 1, 3. |
| Eleocharis camptotriche. | | | | | | |
| " Schweinitzii C. B. Clarke. | | + | + | | | Guadeloupe. |
| " capitata (Willd.) R. Br. | + | | + | + | + | Cat. 1, 2, 5. |
| " ochreata Nees. | + | | | + | + | 1. |
| Dichromena colorata(L.)A. S. Hitch. | + | + | + | + | + | Crooked, Fort., Inagua, 4, 5. |
| Fimbristylis spadicea (L.) Vahl. | + | + | | + | + | Cat, Crooked, Fortune, Inagua, 1. |
| " monostachya (L.) Hassk. | | + | + | | | 1. |
| Rynchospora cyperoides (Sw.) Mart. | + | | + | | | Inagua, 1, 3, 4, 5. |
| " microcarpa Baldw. | | + | + | + | + | Bahama, 5. |
| Cladium Jamaicense Crantz. | + | + | + | | | Crooked, 4, 5. |
| Scleria filiformis Sw. | | + | | | | |
| PALMAE. | | | | | | |
| Thrinax Bahamense Cook. | + | + | | | | Eleuthera, Cat, 1, 2, 4, 6. |
| Paurotis Androsana Cook. | | + | | | | |
| Cyclospathe Northropi Cook. | + | + | + | + | | |
| BROMELIACEAE. | | | | | | |
| Tillandsia Balbisiana R. & S. | + | + | + | + | | 1. |
| " bulbosa Hook. | | + | + | + | | Cat, Inagua, 1, 5. |
| " fasciculata Sw. | | + | + | + | | Crooked, Inagua, 1, 3, 4, 5 |
| " flexuosa Sw. | | + | + | + | | Inagua, 1, 5. |
| " recurvata L. | | + | + | + | | Cat, 1, 2, 3, 4, 5. |
| " utriculata L. | | + | + | + | | Cat, Inagua, 1, 2, 3, 5. |
| COMMELINACEAE. | | | | | | |
| Commelina nudiflora L. | + | | + | + | + | Widely dis., 1, 2, 3, 4, 5. |
| Rhœa discolor (L'Her) Hance. | + | + | + | | | 1, 2, 3, 4. |
| LILIACEAE. | | | | | | |
| Aletris bracteata Northr. | | + | | | | |
| SMILACEAE. | | | | | | |
| Smilax auriculata Walt. | + | + | | + | + | |
| " Havanensis Jacq. | + | + | + | + | | 2, 4, 5, 6. |
| AMARYLLIDACEAE. | | | | | | |
| Agave rigida Mill. | | + | | | | 4. |
| " " Sisalana Engl. | + | + | | + | | 4. |
| Hymenocallis arenicola Northr. | | + | | | | |
| Furcraea Cubensis Haw. | + | | + | | | 1, 2, 3, 5. |
| Hypoxis juncea Smith. | | + | + | + | + | |

| Names of Species. | N. P. | Andros. | Cuba. | S. Fla. | S. U. S. | |
|---|---|---|---|---|---|---|
| **DIOSCORACEAE.** | | | | | | |
| Rajania hastata L. | + | + | + | | | Cat, 2. |
| **ORCHIDACEAE.** | | | | | | |
| Bletia verecunda R. Br. | + | + | + | + | | 1, 4. |
| Epidendrum fucatum Lindl. | | + | + | | | |
| " nocturnum L. | | + | + | + | | 1, 3, 5. |
| " Phoenicium Lindl. | | + | + | | | |
| " odoratissimum Lindl. | | + | | | | |
| Limodorum tuberosum L. | | + | + | + | + | |
| Stenorrhynchus orchioides (Rich.). | | + | + | | | 1, 3, 5. |
| Gyrostachys tortilis (Rich.). | | + | + | + | + | 1, 3. |
| Oncidium sylvestre Lindl. | | + | + | | | 1. |
| " variegatum Sw. | | + | + | | | 1, 2, 3, 6. |
| Govenia utriculata Lindl. | | + | + | | | 1, 5. |
| Polystachya luteola Hook. | | + | + | + | | 1, 2, 3, 5. |
| Broughtonia lilacina Henfr. | | + | + | | | 1, 6. |
| Vanilla articulata Northr. | | + | + | | | |
| **CASUARINACEAE.** | | | | | | |
| Casuarina equisetifolia Forst. | + | + | + | + | | Crooked. Widely dis., nat. |
| **MYRICACEAE.** | | | | | | |
| Myrica cerifera L. | | + | | + | + | |
| **MORACEAE.** | | | | | | |
| Ficus dimidiata Griseb. | + | + | + | | | Eleuthera, 1. |
| " pedunculata Willd. | + | | + | + | | 1, 2. |
| " pertusa L. | | + | + | | | Cat, 1, 3, 4. |
| **ULMACEAE.** | | | | | | |
| Trema Lima (Lam.) A. S. Hitch. | + | + | + | + | | 1, 2, 3, 4, 5. Eleuthera. |
| **URTICACEAE.** | | | | | | |
| Fleurya aestuans Gaud. | + | | + | | | 1, 2, 3, 4, 5. |
| Adicea microphylla Sw.) Kuntze. | + | | + | + | | 1, 2, 3, 4, 5, 6. |
| **LORANTHACEAE.** | | | | | | |
| Phoradendron racemosum Kr. & Urb. | | + | + | | | |
| " Northropiae Urb. | | + | | | | |
| Loranthus pauciflorus Sw. | | + | + | | | 1. |
| " uniflorus Jacq. | | + | + | | | 1, 6. |
| **ARISTOLOCHIACEAE.** | | | | | | |
| Aristolochia passifloraefolia Rich. | | + | + | | | |
| " pentandra L. | | + | + | + | | |
| **POLYGONACEAE.** | | | | | | |
| Coccolobis diversifolia Jacq. | + | | + | | | 1, 2, 3. |
| " retusa Griseb. | | + | + | | | 3. |
| " tenuifolia L. | | + | + | | | 1. |
| " uvifera (L.) Jacq. | + | + | + | + | | Cat, Watlings, Crooked, Inagua, 1, 2, 3, 4, 5. |
| " Wrightii Lindau. | | + | + | | | |
| " obtusifolia Jacq. | | + | | | | |
| Polygonum Portoricense Bertero. | | + | + | + | + | 1, 5. |
| **CHENOPODIACEAE.** | | | | | | |
| Atriplex cristata H.B.K. | + | + | + | + | | 2. |

| Names of Species. | N. P. | Andros. | Cuba. | S. Fla. | S. U. S. | |
|---|---|---|---|---|---|---|
| CHENOPODIACEAE.—*Continued.* | | | | | | |
| Salicornia ambigua Michx. | + | + | + | + | + | Crooked. |
| " Bigelovii Torr. | | + | | + | + | |
| Dondia fruticosa (Forsk.) | | + | + | | | |
| " linearis (Moq.) Millsp. | + | | | + | | |
| AMARANTACEAE. | | | | | | |
| Alternanthera muscoides Sw. | + | | + | | | Inagua, 3. |
| " paronychioides St. Hil. | + | | | | | |
| Lithophila vermicularis (L.) Uline. | + | + | + | + | + | Eleuthera. Widely dis. |
| Iresine paniculata (L.) Kuntze. | | + | + | + | + | Eleuth., Cat, Watlings. Widely dis. |
| BATIDEAE. | | | | | | |
| Batis maritima L. | | + | + | + | + | Inagua, 1, 2, 3, 5. |
| PHYTOLACCACEAE. | | | | | | |
| Rivina humilis glabra L. | + | + | + | + | + | 1, 2, 3, 4, 5, Cat. |
| Phytolacca octandra L. | | + | + | | | 1, 3, 4, 5. |
| NYCTAGINACEAE. | | | | | | |
| Mirabilis Jalapa L. | + | | + | | | Fortune, 1, 3, 4, 5. |
| Boerhaavia erecta L | + | | + | + | + | 1, 3, 4. |
| " paniculata Rich. | + | + | + | | + | Eleuthera, 1, 2, 3, 4. |
| " scandens L. | + | | + | | | Eleuthera, 1, 4, 5. |
| Pisonia aculeata L. | + | + | + | + | | 1, 3, 4, 5. |
| " obtusata Swz. | + | + | + | + | | Crooked, 1, 3, 5. |
| " rotundata Griseb. | | + | + | + | | |
| AIZOACEAE. | | | | | | |
| Sesuvium portulacastrum L. | + | + | + | + | + | Widely distributed. Eleuthera, Cat, Crooked, Fortune. |
| PORTULACACEAE. | | | | | | |
| Portulaca oleracea L. | + | + | + | + | + | Eleuthera, Inagua. Widel distributed. |
| " halimoides L. | | + | | + | | 1, 2, 3. |
| ANONACEAE. | | | | | | |
| Anona palustris L. | | + | + | | | 1, 2, 3, 5. |
| RANUNCULACEAE. | | | | | | |
| Clematis dioica L. | | + | + | | | 1, 3, 4, 5. |
| LAURACEAE. | | | | | | |
| Nectandra sanguinea Rottb. | + | + | + | | | 1, 3, 4, 5. |
| Cassytha filiformis L. | + | + | + | + | | Eleuthera, Cat, 1, 2, 3, 4, 5 |
| PAPAVERACEAE. | | | | | | |
| Argemone Mexicana L. | + | | + | + | + | Eleuth., Crooked, Fortune Inagua. Widely dis. |
| CRUCIFERAE. | | | | | | |
| Brassica arvensis (L.) B.S.P. | + | | | | + | Int. from Europe, 2. |
| Lepidium Virginicum L. | + | | + | + | + | Eleuthera, Cat, Inagua 1, 2, 3, 4. |
| Cakile aequalis L'Her. | + | + | + | + | + | 1, 2, 3. |
| CAPPARIDACEAE. | | | | | | |
| Pedicellaria pentaphylla (L.) Schrank. | + | + | + | + | + | Eleuthera. Widely dis. |

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|---|---|---|---|---|---|---|
| CRASSULACEAE. | | | | | | |
| Bryophyllum pinnatum (Lam.) S. Kurz. | + | + | | + | | Widely distributed. |
| ROSACEAE. | | | | | | |
| Chrysobalanus Icaco L. | + | + | + | + | | Widely distributed. |
| MIMOSACEAE. | | | | | | |
| Acacia choriophylla Benth. | + | + | | | | |
| " Farnesiana (L.) Willd. | + | | + | + | + | Widely distributed. Fortune, Inagua, 1, 3, 5. |
| Acuan depressa (Kth.) Kuntze. | | + | | + | | Inagua, 1, 2, 3, 4, 5. |
| " virgata (Willd.) Kuntze. | + | + | + | + | | Eleuthera. Widely dis. |
| Mimosa pudica L. | | + | + | | | Widely distributed. |
| Leucaena glauca (L.) Benth. | + | + | + | + | | Widely distributed. Eleuthera, Cat, Fortune. |
| Lysiloma paucifoliola (DC.) Hitch. | + | + | + | | | Eleuthera, Fortune. |
| " Bahamensis Benth. | + | | + | + | | Cat, Fortune, Inagua. |
| Calliandra formosa Benth. | + | | | | | |
| Pithecolobium Hystrix Benth. | | + | + | | | |
| " Unguis-cati (L.) Bth. | + | + | + | + | | Eleuthera, Cat, Fort., 1, 2. |
| " Bahamense Northr. | | + | | | | |
| CAESALPINACEAE. | | | | | | |
| Cassia Bahamensis Mill. | + | | | + | | Eleuthera, Cat, Watlings. 1, 3. |
| " biflora L. | + | | + | + | | Eleuthera, Fort., Inagua, 1, 2, 3, 4, 5, 6. |
| " ligustrina L. | + | + | + | | | 1, 5. |
| " mimosoides L. | + | | | | | Eastern Hemisphere. |
| " occidentalis L. | + | | + | + | + | Widely distributed. Eleuthera, Fortune, Inagua. |
| " polyadena DC. | + | + | + | | | Cat, Crooked, 1, 3. |
| " villosa Mill. | + | | | | | 4. |
| " Caribaea Northr. | | + | | | | |
| Tamarindus Indica L. | + | + | + | | | Inagua, 1. |
| Haematoxylon Campechianum L. | + | + | + | | | 1, 2. |
| Caesalpinia ovalifolia Urb. | + | + | | | | |
| " crista L. | + | + | + | + | | Eleuthera, Inagua. |
| Caesalpinia Rugdioma L. | + | + | + | | | Inagua, 3. |
| Peltophorum adnatum Griseb. | | + | + | | | |
| PAPILIONACEAE. | | | | | | |
| Sophora tomentosa L. | | + | + | + | | Crooked, Fortune, Inagua. Widely distributed. |
| Crotalaria pumila Ort. | + | | + | + | + | Eleuthera, Cat, 1, 2, 3, 4, 5. |
| " retusa L. | + | | + | | | Widely distributed. |
| " verrucosa L. | + | | | | | 1, 2, 3 (from Old World). |
| Indigofera Anil L. | + | | + | + | + | Eleuthera, Inagua. Widely distributed. |
| Cracca Schottii Vail. | | + | | | | Asia. |
| Stylosanthes hamata (L.) Taub. | + | | + | | | Eleuthera, Fortune, Inagua. Widely distributed. |
| Meibomia incana (Sw.) Kuntze. | + | + | + | + | | Eleuthera, Cat. Widely dis. |
| Abrus precatorius L. | + | | | | | 1, 2, 3, 5. Widely dis. |
| Bradburya Virginiana (L.) Kuntze. | + | + | + | + | + | Eleuthera, Cat, Crooked, Inagua. Widely dis. |
| " angustifolia (DC.) Griseb. | + | + | + | + | + | Cat. Widely distributed. |

| Names of Species. | N. P. | Andros. | Cuba. | S. Fla. | S. U. S. | |
|---|---|---|---|---|---|---|
| PAPILIONACEAE.—*Continued.* | | | | | | |
| Galactia rudolphioides (Griseb.) Wr. | + | + | + | | | Eleuthera, Cat, Crooked. |
| Galactia Cubensis H.B.K. | + | + | + | + | + | Watlings, Inagua. Widely distributed. |
| Canavalia obtusifolia (Lam.) DC. | + | + | + | + | | Eleuthera Inagua. Widely distributed. |
| Rhynchosia minima (L.) DC. | + | | + | + | + | Inagua. Widely dis. |
| Phaseolus semierectus L. | + | + | + | | | Widely distributed. |
| Vigna repens (L.) Kuntze. | | + | | + | + | 1, 2, 3, 4, 5. |
| Cajanus Cajan (L.) Millsp. | + | + | + | | | Eleuthera. Widely dis. |
| Dalbergia Brownei (Pers.) Kuntze. | | + | + | + | | Widely distributed. |
| Ichthyomethia Piscipula (L.) Hitch. | | + | | + | | Cat, 1, 2, 3, 4, 5. |
| OXALIDACEAE. | | | | | | |
| Oxalis corniculata repens Zucc. | + | | + | + | + | Widely distributed. |
| LINACEAE. | | | | | | |
| Linum Bahamense Northr | + | + | | | | |
| Erythroxylon brevipes DC. | | + | + | | | Fortune, 1. |
| " obovatum Macf. | | + | + | | | 1, 3. |
| " reticulatum Northr. | | + | | | | |
| MALPHIGIACEAE. | | | | | | |
| Byrsonima lucida Rich. | | + | + | + | | 2, 3. |
| Malphigia setosa Spr. | | + | + | | | Cat, 6. |
| Stigmaphyllon Sagraenum Juss. | | + | + | | | |
| Triopteris rigida Sw. | + | + | + | | | 6. |
| RUTACEAE. | | | | | | |
| Xanthoxylon cribrosum Spr. | | + | | + | | |
| " emarginatum Sw. | | + | + | | | Cat, Inagua, 1. |
| Fagara Fagara (L.) Small. | + | + | + | + | + | Eleuthera, Cat, 1, 3, 4. |
| SIMARUBACEAE. | | | | | | |
| Suriana maritima L. | + | + | + | + | | Eleuthera, Cat, Crooked, 2. |
| Picrodendron baccatum Bahamense. | | + | + | | | 1. |
| BURSERACEAE. | | | | | | |
| Bursera Simaruba (L.) Sarg. | + | + | + | + | | Eleuthera, Cat, Crooked, 1, 2, 3, 4, 5. |
| Swietenia Mahogani L. | + | + | + | + | | Crooked, Inagua, 1, 2, 4, 5. |
| POLYGALACEAE. | | | | | | |
| Polygala Boykinii Nutt. | | + | | + | + | |
| " brizoides St. Hil. | | + | + | | | 1, 4, 5. |
| " spathulata Griseb. | | + | | | | |
| EUPHORBIACEAE. | | | | | | |
| Phyllanthus Bahamensis Urb. | | + | | | | |
| " Epiphyllanthus L. | + | + | + | | | Eleuthera, Cat, Watlings, Fortune, Inagua, 1, 2. |
| " Niruri L. | | + | + | + | | Fortune, Inagua, widely dis. |
| Croton linearis Jacq. | + | + | + | + | | Eleuthera, Cat, 1. |
| Savia erythroxyloides Griseb. | | + | | | | |
| Acalypha alopecuroides Jacq. | + | | + | | | Eleuthera, 4, 5. |
| Lasiocroton macrophyllus Griseb. | | + | | | | 1. |
| Excoecaria lucida Sw. | | + | + | + | | 1, 3. |
| " Sagraei J. Mull. | | + | + | | | |

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|---|---|---|---|---|---|---|
| EUPHORBIACEAE.—*Continued.* | | | | | | |
| Hippomane Mancinella L. | | + | + | + | | Inagua, 1, 2, 3, 4, 5. |
| Bonania emarginata DC. | | + | + | | | |
| Euphorbia Blodgettii Engelm. | + | + | | + | | Eleuthera, Cat, Crooked, Fortune, Inagua, 1. |
| " buxifolia Lam. | + | + | + | + | | Eleuthera, Cat, Watlings, Crooked, Inagua, 1, 2, 3, 4, 5. |
| " cassythoides Boiss. | | + | | | | |
| " heterophylla L. | + | + | + | + | + | Eleuthera, Cat, Crooked, Inagua, 1, 2, 4, 5. |
| " " graminifolia Engelm. | + | + | + | + | + | Eleuthera, Cat, Fortune, Inagua, 1, 2. 4, 5. |
| " nutans Lag. | + | + | + | + | + | Widely distributed. Eleuthera, Inagua. |
| " serpens Kth. | + | | + | + | + | 3, 5. |
| Buxus Bahamensis Baker. | | + | | | | |
| ANACARDIACEAE. | | | | | | |
| Metopium Metopium (L.) Small. | + | + | + | + | | Cat, Crooked, Inagua, 1. |
| CELASTRACEAE. | | | | | | |
| Elaeodendron xylocarpum DC. | + | | | | | Bermudas. |
| Maytenus buxifolius (Rich.) Griseb. | | + | + | | | Cat, Crooked. |
| Crossopetalum pallens (Smith). | | + | + | + | | 2, 3. |
| " coriaceum Northr. | | + | | | | |
| Schaefferia frutescens Jacq. | | + | + | + | | Eleuthera, 1, 2, 3, 4, 5. |
| ILICACEAE. | | | | | | |
| Ilex sideroxyloides Griseb. | | + | | | | 3. |
| SAPINDACEAE. | | | | | | |
| Serjania diversifolia Radlk. | | + | + | | | |
| " subdentata Juss & Poir. | + | + | + | | | Eleuthera, Cat, 1, 2, 3. |
| Cardiospermum Halicacabum L. | + | | + | + | + | Widely distributed. |
| Thouinia discolor Griseb. | + | + | | | | Eleuthera, Cat, Fortune, Inagua. |
| Exothea paniculata (Juss.) Radlk. | | + | + | + | | 1. |
| Hypelate trifoliata Sw. | | + | + | + | | 1. |
| Alvaradoa amorphioides Liebm. | + | | + | | | 4. |
| RHAMNACEAE. | | | | | | |
| Krugiodendron ferreum (Vahl.) Urb. | | + | | + | | 1, 2, 3. |
| Colubrina ferruginosa Brongn. | | + | + | | | 1, 2, 3. |
| Reynosia latifolia Griseb. | | + | + | + | | Eleuthera, Cat, 2. |
| " Northropiana Urb. | | | | | | |
| Gouania Domingensis L. | + | + | + | + | | 1, 2, 3, 5. |
| VITACEAE. | | | | | | |
| Vitis rotundifolia Michx. | + | + | | + | + | |
| " alata Jacq. | | + | + | | | |
| " trifoliata (L.) Bak. | | + | + | | | 1, 2, 3, 5. |
| Cissus sicyoides L. | + | + | + | + | | 1, 2, 3, 4, 5. |
| Parthenocissus quinquefolia (L.) Planch. | + | | + | + | + | |
| TILIACEAE. | | | | | | |
| Triumfetta semitriloba L. | + | | + | + | | Widely distributed. |

| Names of Species. | N. P. | Andros. | Cuba. | S. Fla. | S. U. S. | |
|---|---|---|---|---|---|---|
| TILIACEAE.—*Continued.* | | | | | | |
| Corchorus hirsutus L. | + | + | + | | | Eleuthera, Cat, Crooked, Watlings, Inagua, 1, 2, 3. |
| " siliquosus L. | + | | + | + | + | Eleuthera, 1, 2, 3, 4, 5, 6. |
| MALVACEAE. | | | | | | |
| Sida carpinifolia L. | + | + | + | + | | Eleuthera, Inagua. Widely distributed. |
| " supina L'Her. | + | | | + | | 2, 3, 4, 5, 6. |
| Abutilon crispum Don | | + | + | + | + | Eleuthera, 3, 4, 5. |
| Pavonia spicata Cav. | | + | + | + | | 1, 2, 3, 5. |
| Hibiscus cryptocarpus Rich. | | + | + | | | |
| " tiliaceus L. | | + | + | + | | Widely distributed. |
| STERCULIACEAE. | | | | | | |
| Helicteres semitriloba Bert. | | + | + | | | Inagua, 6. |
| " spiralis Northr. | | + | | | | |
| Melochia nodiflora Sw. | + | | + | | | 1, 2, 3, 4, 5. |
| " tomentosa L. | + | + | + | | | Eleuthera, Cat, Inagua, 1, 2, 3, 4, 5. |
| Waltheria Americana L. | + | + | + | + | + | Eleuthera, Cat, Fortune. Widely distributed. |
| HYPERICACEAE. | | | | | | |
| Ascyrum hypericoides L. | + | + | + | + | + | 1, 4, 5. |
| BIXACEAE. | | | | | | |
| Xylosma ilicifolium Northr. | + | + | | | | |
| CANELLACEAE. | | | | | | |
| Canella Winterana (L.) Gaertn. | + | + | + | + | | 1, 2, 3. |
| TURNERACEAE. | | | | | | |
| Turnera ulmifolia L. | + | + | + | | | Eleuthera, Cat, Fortune, 1, 2, 3, 4, 5. |
| PASSIFLORACEAE. | | | | | | |
| Passiflora angustifolia Sw. | | + | + | + | | 1. |
| " cupraea L. | + | + | + | | | Eleuthera, Cat. |
| " minima L. | + | + | + | | | Eleuthera, Inagua, 1, 6. |
| " multiflora L. | | + | + | + | | |
| " pectinata Griseb. | | + | | | | Turk. |
| CACTACEAE. | | | | | | |
| Cereus Swartzii Griseb. | | + | | | | Cat, Crooked, Inagua, 1. |
| Opuntia spinosissima Mill. | | + | | | | Fortune, Inagua, 1, 2. |
| " Tuna (L.) Mill. | | + | + | + | + | Crooked, Inagua, 1, 2, 3, 4, 5. |
| LYTHRACEAE. | | | | | | |
| Parsonsia Parsonsia (L.) Britton. | + | | + | | | 1. |
| RHIZOPHORACEAE. | | | | | | |
| Rhizophora Mangle L. | + | + | + | + | | Cat, Crooked. Widely dis. |
| MYRTACEAE. | | | | | | |
| Calyptranthes pallens Griseb. | | + | + | | | 1, 2, 3. |
| Myrtus punctata Griseb | | + | | | | 2, 3, 6. |
| Eugenia axillaris (Sw.) Willd. | | + | + | | | 1, 2. |
| " longipes Berg. | | + | | + | | |
| " monticola DC. | + | + | + | + | | Eleuthera, 1, 2, 3. |

| Names of Species. | N. P. | Andros. | Cuba. | S. Fla. | S. U. S. | |
|---|---|---|---|---|---|---|
| COMBRETACEAE. | | | | | | |
| Conocarpus erecta L. | + | + | + | + | | Eleuthera, Cat, Watlings, Crooked, Inagua. Widely distributed. |
| Laguncularia racemosa (L.) Gaertn. | | + | + | + | | Fortune, Crooked. Widely distributed. |
| Terminalia spinosa Northr. | | + | | | | |
| MELASTOMACEAE. | | | | | | |
| Tetrazygia bicolor (Mill) Cogn. | + | + | + | | | |
| ONOGRACEAE. | | | | | | |
| Jussiaea suffruticosa L. | + | | + | | | Widely distributed. |
| SAMYDACEAE. | | | | | | |
| Casearia laetioides (Rich.) | | + | + | | | 1, 4. |
| Banara reticulata Griseb. | + | + | + | | | |
| UMBELLIFERAE. | | | | | | |
| Hydrocotyle pygmaea Wright. | | + | + | | | |
| Centella Asiatica (L ) Urb. | | + | | + | + | Widely distributed. |
| MYRSINACEAE. | | | | | | |
| Rapania Guyanensis (Aubl.) | | + | + | + | | 1, 3, 4, 5. |
| Icaconea paniculata (Nutt.) Sudw. | + | | + | + | | 4. |
| Jacquinia Keyensis Mez. | + | + | | + | | Eleuthera, Cat, Crooked 1, 2, 3, 4, 5, 6. |
| PRIMULACEAE. | | | | | | |
| Samolus ebracteatus Kth. | | + | | + | + | |
| PLUMBAGINACEAE. | | | | | | |
| Plumbago scandens L. | + | | + | + | | Inagua, 1, 2, 3, 4, 5. |
| SAPOTACEAE. | | | | | | |
| Chrysophyllum oliviforme Lam. | + | + | + | + | | 1, 2, 6. |
| Lucuma pauciflora A. DC. | | + | + | | | |
| Sideroxylon mastichodendron Jacq. | | + | + | | | 1, 2, 3, 6. |
| Bumelia microphylla Griseb. | | + | | | | |
| " Cubensis Griseb. | | + | + | | | |
| Dipholis salicifolia A. DC. | + | + | + | + | | 1, 2, 3. |
| Mimusops dissecta R. Br. | + | + | | + | | 3. |
| " Floridana Engelm. | | + | | + | | |
| EBENACEAE. | | | | | | |
| Maba Caribaea (A. DC.) Hiern. | | + | + | | | 2. |
| OLEACEAE. | | | | | | |
| Adelia porulosa (Poir.) Engler. | | + | + | + | + | 1, 2, 4. |
| LOGANIACEAE. | | | | | | |
| Spigelia Anthelmia L. | | + | + | | | Eleuthera, Fort., 1, 3, 4, 5. |
| Cynoctonum mitreola (L.) Britt. | | + | + | + | + | 1, 3, 4, 5, 6. |
| " sessilifolia (T. & G.) Britt. | | + | | + | + | |
| GENTIANACEAE. | | | | | | |
| Voyria Mexicana Griseb. | | + | + | + | | 1. |
| Eustoma exaltatum Griseb. | + | + | + | + | + | 1, 4, 5, 6. |
| Sabbatia campanulata (L.) Torr. | + | + | | + | + | |

| Names of Species. | N. P. | Andros. | Cuba. | S. Fla. | S. U. S. | |
|---|---|---|---|---|---|---|
| APOCYNACEAE. | | | | | | |
| Vinca rosea L. | + | | + | + | | Widely distributed. |
| Plumiera obtusa L. | | + | + | | | Cat, 1, 2, Fortune, Inagua. |
| Echites Andrewsii Chapm. | + | + | + | + | | Eleuthera, Cat, Watlings, 1, 2, 3, 4. |
| " biflora Jacq. | | + | | | | 3, 5. |
| " Sagraei A. DC. | + | + | + | + | | |
| " umbellata Jacq. | + | + | + | + | | Eleuthera, Cat, Fortune, Crooked, Inagua, 1, 4, 6. |
| ASCLEPIADACEAE. | | | | | | |
| Asclepias Curassavica L. | + | | + | + | | Widely distributed. |
| Metastelma Bahamense Griseb. | | + | + | | | |
| " barbatum Northr. | | + | | | | |
| " palustre Schltr. | + | + | | + | + | Fortune, Inagua, 2. |
| CONVOLVULACEAE. | | | | | | |
| Ipomoea cathartica Poir. | + | | + | | | 1, 3, 4, 5. |
| " coccinea L. | + | | | + | + | Widely distributed. |
| " commutata R & S. | + | | | + | + | 1, 5. |
| " fastigiata Sweet. | | + | + | + | | 1, 2, 3, 4, 5. |
| " heptaphylla Griseb. | | + | + | | | |
| " Jamaicensis Don. | + | + | + | | | Eleuthera, 1, 4, 5. |
| " grandiflora Lam. | + | + | | | | |
| " Pes-caprae (L.) Sweet. | + | + | + | + | + | Fortune, Inagua. Widely distributed. |
| " repanda Jacq. | | + | + | | | Eleuthera, Cat, Fortune, 3. |
| " sidifolia Chois. | + | | + | | | 1, 4, 6. |
| " sinuata Ort. | + | + | + | + | + | Eleuthera. Widely dis. |
| " triloba L. | + | + | + | + | | Eleuthera, Fortune, Inagua, Crooked. Widely dis. |
| Jacquemontia Jamaicensis (Jacq.) Hall. | + | + | + | | | Eleuthera, Cat, Crooked, Inagua, 1, 6. |
| " verticillata (L.) Urb. | | + | + | | | 1, 3, 5. |
| Evolvulus arbuscula Poir. | | + | + | | | Eleuthera, Fortune, Inagua, 1, 6. |
| Dichondra repens Forst. | + | | + | + | + | Widely distributed. |
| CUSCUTACEAE. | | | | | | |
| Cuscuta Americana L. | | + | + | | | Eleuthera, 1, 2, 3, 4, 5. |
| HYDROPHYLLACEAE. | | | | | | |
| Nama Jamaicensis L. | + | | + | + | + | 1, 4 6. |
| BORAGINACEAE. | | | | | | |
| Cordia angustifolia R. & S. | | + | + | | | |
| " lima R. & S. | | + | | | | 6. |
| " Sebestena L. | + | + | + | + | | Inagua, 1, 3, 5. |
| Bourreria Havanensis (Willd.) Miers. | + | + | + | + | | Eleuthera, Cat, Crooked, Fortune, 1. |
| Tournefortia gnaphalodes (Jacq.) R. Br. | + | + | + | + | | Eleuthera, Watlings, Inagua, 1, 2, 3. |
| Tournefortia volubilis L. | + | + | + | + | + | Eleuthera, Inagua, 1, 2, 3, 5. |
| Heliotropium Curassavicum L. | + | + | + | + | | Cat, Crooked, Inagua. Widely distributed. |
| " parviflorum L. | + | | + | + | | Eleuthera, Cat, Inagua, 1, 2, 3, 4, 5. |
| " nanum Northr. | | + | | | | |

| Names of Species. | N. P. | Andros. | Cuba. | S. Fla. | S. U. S. | |
|---|---|---|---|---|---|---|
| VERBENACEAE. | | | | | | |
| Lantana Camara L. | + | + | + | + | + | Watlings, 1, 2, 3, 4, 5, 6. |
| " crocea Jacq. | | + | + | | | Eleuthera, Cat, 1, 3, 5, 6. |
| " involucrata L. | + | + | + | + | | Eleuth., Watlings, Crooked Cat, Inag., 1, 2, 3, 4, 5. |
| Lippia canescens Kth. | + | | | | | |
| " nodiflora (L.) Michx. | + | + | + | + | + | Eleuthera, Cat, Inagua. Widely distributed. |
| Abena Jamaicensis (L.) A. S. Hitch. | + | | + | + | | Eleuthera, Cat, Crooked, Inagua. Widely dis. |
| Citharexylum Berterii Spreng. | | + | + | | | 1. |
| " lucidum Cham. & Schl. | | + | + | | | 1, 3, 4, 5. |
| Duranta repens L. | + | + | + | + | | Eleuthera, 1, 2, 3, 4, 5. |
| Petitia Domingensis Jacq. | | + | | | | 1, 6, Grand Cayman. |
| Vitex ilicifolia Rich. | | + | + | | | |
| Avicennia nitida Jacq. | + | + | + | + | | Fortune, widely distributed. |
| LABIATAE. | | | | | | |
| Micromeria Brownei Benth. | | + | | + | | 1, 5. |
| Salvia occidentalis Sw. | + | | + | + | | 1, 3, 4, 5. |
| " serotina L. | + | | + | + | | Eleuthera, Cat, Watlings, Crooked, Inag., 1 2, 3, 4. |
| Leonurus Sibiricus L. | + | | + | + | + | Widely distributed. |
| Leonotis nepetaefolia (L.) R. Br. | + | | + | + | + | Eleuthera, Inagua. Widely distributed. |
| Teucrium Cubense L. | + | | + | | + | Cat, Inagua, 4, 5. |
| Mesosphaerum pectinatum (Poit.) Kuntze. | | + | + | + | | Inagua. Widely distributed. |
| SOLANACEAE. | | | | | | |
| Solanum aculeatissimum Jacq. | + | + | + | + | + | 1, 2, 4, 5. |
| " Bahamense L. | + | + | + | + | | Eleuthera, Cat, Watlings, Crooked, 1, 2, 3, 4. |
| " nigrum L. | + | | + | + | + | Inagua, 1, 2, 4. |
| " " nodiflorum Gray. | + | + | + | | | Inagua, 1, 3. |
| " verbascifolium L. | + | + | + | + | | Eleuthera. Widely dis. |
| Physalis angulata L. | | + | + | + | + | 1, 2, 3, 5. |
| " Barbadensis Jacq. | | + | | | + | Widely distributed. |
| Capsicum baccatum L. | + | | + | | | 3. |
| Cestrum pallidum Lam. | + | + | | | | Cat, 1, 6. |
| Datura Metel L. | | + | + | + | + | Inagua. Widely dis. |
| SCROPHULARIACEAE. | | | | | | |
| Stemodia maritima L. | + | | + | | | Eleuthera, 1, 5. |
| Capraria biflora L. | + | + | + | + | | Cat, Watlings, Crooked, Inagua. Widely dis. |
| Buchnera elongata Sw. | | + | + | + | + | 1, 3, 4, 5. |
| Gerardia maritima Raf. | | + | | + | + | |
| " purpurea L. | | + | | + | + | |
| LENTIBULARIACEAE. | | | | | | |
| Pinguicula pumila Michx. | | + | | + | + | |
| BIGNONIACEAE. | | | | | | |
| Tecoma lepidophylla Griseb. | | + | + | | | |
| " Bahamensis Northr. | + | + | | | | |
| " stans (L.) Juss. | + | | + | + | | Inagua, 1, 2, 3, 4. |
| Jacaranda Bahamensis R. Br. | | + | | | | |

| Names of Species. | N. P. | Andros | Cuba. | S. Fla. | S. U. S. | |
|---|---|---|---|---|---|---|
| BIGNONIACEAE. —*Continued.* | | | | | | |
| Jacaranda coerulea Griseb. | + | | | | | Cat. |
| ACANTHACEAE. | | | | | | |
| Thunbergia fragrans Roxb. | + | | | | | 1, 3 (East Indies). |
| Blechum Brownei Juss. | + | | + | | | Widely distributed. |
| Anthacanthus acicularis (Sw.) Nees. | + | + | + | | | 3. |
| Dicliptera assurgens Juss. | + | | + | + | | 1, 3, 4, 5. |
| RUBIACEAE. | | | | | | |
| Exostemma Caribaeum (Jacq.) R.&S. | | + | + | + | | Crooked, 1, 2, 3, 4, 5. |
| Rhacicallis Americana (Jacq.) Hitch. | + | + | + | | | Crooked, 1. |
| Catesbaea spinosa L. | | + | + | | | 1. |
| " fasciculata Northr. | | + | | | | |
| Randia aculeata L. | + | + | + | + | | Eleuthera, Cat, Crooked, Inagua, 1, 2, 3, 6. |
| Genipa clusiaefolia (Jacq ) Griseb. | + | + | + | + | | Cat, Watlings, Crooked, Fortune. |
| Guettarda elliptica Sw. | + | + | + | + | | Eleuthera, Fortune, Inagua, 1, 4. |
| " scabra Lam. | + | + | + | + | | Inagua, 1, 2, 3, 4, 5. |
| Antirrhoea lucida Gaertn. | | + | + | | | 1, 2, 3, 6. |
| " myrtifolia Griseb. | | + | + | | | |
| Erithalis fruticosa L. | + | + | + | + | | Eleuthera, Cat, Watlings, Fort, Crooked, Inagua, 1, 2, 3, 4. |
| " rotundata Griseb. | | + | + | | | |
| Chiococca parvifolia Wulls. | + | + | + | + | | Crooked, 1, 3, 4, 5. |
| " alba (L.) A. S. Hitch. | + | + | + | + | | Eleuthera, Cat, 1, 2, 3, 4, 5. |
| " sp. | | + | | | | |
| Phialanthus myrtilloides Griseb. | | + | + | | | Crooked. |
| Strumpfia maritima Jacq. | + | + | + | + | | Eleuth., Watlings, Crooked, 3. |
| Morinda Royoc L. | | + | + | + | | 1, 2, 6. |
| Myrstiphyllum pubescens (Sw.) A. S. Hitch. | | + | + | | | 1, 4. |
| Myrstiphyllum undatum (Jacq.) Hitch. | + | + | | + | | Eleuthera, Cat, 1. |
| " ligustrifolium Northr. | | + | | | | |
| Ernodea littoralis Sw. | + | + | | + | | Cat, Watlings, Crooked, Fortune, Inagua, 1, 3. |
| Hamelia patens Jacq. | + | | + | + | | 1, 2, 3, 4, 5. |
| Spermacoce tenuior Lam. | + | | + | + | | Cat, Crooked, Inagua, Fortune, Eleuth., 1, 2, 3, 4, 5. |
| Relbunium hypocarpium (L.) Hemsl. | | + | | | | 1, 3, 4, 5, 6. |
| CUCURBITACEAE. | | | | | | |
| Anguria Keithii Northr. | | + | | | | |
| Trianosperma racemosa (Griseb.) T. & G. | | + | | | | 1, 5, 6. |
| GOODENIACEAE. | | | | | | |
| Scaevola Plumieri (L.) Vahl. | + | + | + | + | | Eleuthera, Crooked. Widely distributed. |
| COMPOSITAE. | | | | | | |
| Vernonia Bahamensis Griseb. | + | + | | | | Cat, Inagua. |
| Ageratum conyzoides L. | + | | + | + | + | Fortune, Inagua. Widely distributed. |

| Names of Species. | N. P. | Andros. | Cuba. | S. Fla. | S. U. S. | |
|---|---|---|---|---|---|---|
| COMPOSITAE.—*Continued.* | | | | | | |
| Eupatorium ageratifolium DC. | + | | + | + | + | 4, 6. |
| " Bahamense Northr. | | + | | | | |
| " capillifolium (Lam.) Small. | + | | | + | + | |
| " odoratum L. | + | | + | | | 1, 3, 4, 5, 6. |
| " villosum Sw. | + | + | + | + | | Cat, 1. |
| Willugbaeya scandens (L.) Kuntze. | + | + | + | + | + | 1, 3, 4, 5. |
| Aster exilis Ell. | + | + | + | + | + | |
| Baccharis dioica Vahl. | + | + | | | | Eleuthera, Inagua, 1, 2, 3. |
| Erigeron quercifolium Lam. | + | + | | + | + | |
| Pluchea foetida (L.) B.S.P. | | + | | + | + | |
| " camphorata DC. | + | | + | + | + | 1, 3, 4, 5. |
| " odorata (L.) Cass. | + | + | + | + | | Inagua, 1, 2, 3, 4, 5. |
| Parthenium Hysterophorus L. | + | | + | + | + | Eleuthera, Cat, Inagua, 1, 2, 3, 4, 5. |
| Iva cheiranthifolia Kth. | + | | + | | | |
| " imbricata Walt. | | + | | + | + | |
| Ambrosia hispida Pursh. | + | + | + | + | + | Eleuthera, Crooked, Fortune, 1, 4. |
| Isocarpha oppositifolia R. Br. | | + | | | | 1. |
| Borrichia arborescens DC. | + | + | + | + | | Cat, Crooked, 1, 2, 3, 5. |
| Amellus aspera (Jacq.) Kuntze. | + | + | + | + | | Eleuthera, Fortune, 1, 2, 3, 4, 5. |
| Salmea petrobioides Griseb. | + | | | | | Grand Cayman. |
| Bidens leucantha Willd. | + | | + | + | | Eleuthera. Widely dis. |
| Flaveria linearis Lag. | | + | + | + | | |
| Porophyllum ruderale Cass. | | + | + | | | 1, 3, 4, 5. |
| Pectis linifolia L. | + | + | | + | | 1, 2, 3. |
| Neurolaena lobata (L.) R. Br. | | + | + | | | 1, 3, 4, 5. |
| Erechthites hieracifolia (L.) Raf. | | + | | + | + | Widely distributed. |
| Emilia sonchifolia (L.) DC. | + | | + | | | Widely distributed. |
| Anastraphia Northropiana Greenm. | | + | + | | | |
| " paucifloscula Wright. | | + | | | | Fortune Crooked, Inagua, 6. |
| Chaptalia albicans (DC.) H. | | + | + | | | 1, 4, 5. |
| Sonchus oleraceus L. | + | | + | + | + | Eleuthera. Widely dis. |
| Tridax procumbens L. | + | | + | + | | |

## SUMMARY OF ABOVE TABLE

| | |
|---|---|
| Total found on New Providence and Andros (exclusive of cultivated and escaped plants), | 453 |
| Of which are reported also from other islands of the group, | 176 |
| " " " " " " Cuba, | 335 |
| " " " " " " South Florida, | 250 |
| " " " " " " Southern United States, | 108 |
| " " " " " " Jamaica, | 286 |
| " " " " " " Virgin Islands, | 190 |
| " " " " " " Windward Islands, | 223 |
| " " " " " " Mexico and Central America, | 197 |
| " " " " " " South America, | 199 |

Of these 453 species, 76 are widely distributed, being common in warm countries on both continents.

DISTRIBUTION OF THE 128 SPECIES FOUND IN NEW PROVIDENCE AND ANDROS BUT NOT REPORTED FROM CUBA.

| | |
|---|---|
| Peculiar to the Bahamas, | 34 |
| Found also in South Florida, | 47 |
| " " " Southern United States, | 28 |
| " " " Jamaica, | 20 |
| " " " Virgin Islands, | 10 |
| " " " Windward Islands, | 14 |
| " " " Mexico and Central America, | 8 |
| " " " South America, | 10 |
| " " " Haiti. | 10 |

The 34 species that are apparently endemic are as follows: *Pinus Bahamensis, Acacia choriophylla, Buxus Bahamensis, Passiflora pectinata, Jacaranda Bahamensis, Jacaranda caerulea, Vernonia Bahamensis, Thouinia discolor, Caesalpinia ovalifolia, Phyllanthus Bahamensis, Cascaria Bahamensis,* and *Reynosia Northropiana,* and the following described and figured as new in this report: *Thrinax Bahamensis, Paurotis Androsana, Cyclospathe Northropi* (the last two new genera), *Hymenocallis arenicola, Vanilla articulata, Pithecolobium Bahamense, Cassia Caribaea, Linum Bahamense, Erythroxylon reticulatum, Phorodendron Northropiae, Helicteres spiralis, Xylosma ilicifolia, Terminalia spinosa, Tecoma Bahamensis, Catesbaea fasciculata, Myrstiphyllum ligustifolium, Crassopetalum coriaceum, Metastelma barbatum, Heliotropium nanum, Aletris bracteata, Anguria Keithii, Eupatorium Bahamense.* Of the 34 species, 21 were found only on Andros.

Of the other species formerly considered endemic (Report of committee appointed for purpose of exploring the Flora of the Bahamas, W. T. Thiselton-Dyer, Sec., 1888) *Phialanthus myrtilloides* and *Antirrhoea myrtifolia* have since been reported from Cuba; *Salmea petrobioides* has been reported by Hitchcock as occurring in Grand Cayman and *Bletia purpurea* has proved to be not distinct from *B. verecunda.*

DISTRIBUTION OF THE 250 SPECIES FOUND IN NEW PROVIDENCE AND ANDROS AND ALSO IN SOUTH FLORIDA

| | |
|---|---|
| Found also in the United States, north of tropical Florida, | 108 |
| " " " Cuba, | 202 |
| " " " Jamaica, | 198 |
| " " " Virgin Islands, | 149 |
| " " " Windward Islands, | 161 |

| | | |
|---|---|---|
| Found also in | Mexico and Central America, | 153 |
| " " " | South America, | 153 |
| Widely distributed, | | 68 |
| Species not hitherto reported outside of the United States, | | 18 |

Of these 18 species, 4 are limited to tropical Florida, the other 14 extend north of southern Florida.

Of the plants apparently restricted to the United States and the Bahamas, *Dondia linearis* was found only on New Providence; *Smilax auriculata, Vitis rotundifolia, Sabbatia campanulata, Erigeron quercifolium* and *Jacquinia Keyensis* were collected on both islands while the following were found only on the island of Andros: *Iva imbricata, Eugenia longipes, Mimusops Floridana, Myrica cerifera, Pluchea foetida, Salicornia Bigelovii, Polygala Boykinii, Samolus ebracteatus, Mitreola sessilifolia, Gerardia maritima, Gerardia purpurea, Pinguicula pumila.* The last eight were confined to the western side of Andros, growing on the savannas the border of the swash or, in the case of the *Pluchea*, in damp spots in the pines. *Myrica cerifera* is said by Gardiner and Dolley to have been introduced from the United States.

The three reported by Hitchcock as being confined to the United States and the Bahamas are *Xanthium strumarium, Vitis rotundifolia* and *Distichlis spicata* (the last found only in Inagua). The *Vitis*, he observes, may have been carried by birds and the *Smilax, Eugenia,* and *Mimusops* are probably due to the same agency. Many of our seed-eating birds either spend their winters in the Bahamas or stop there on their migrations. Catbirds and mocking birds, for instance, were abundant on Andros during the winter and early spring.

The plants mentioned above as being found on the savannas and bordering the swash on the west side of Andros offer no inducements however to seed-eating birds, the fruits being dry and inconspicuous and the seeds in many cases minute. As has been noted before, the west side of Andros is a paradise for water birds and they are found there in large numbers. Many of these birds, such as the great blue heron (*Ardea herodias*), the little blue heron (*Ardea caerulea*) and the killdeer (*Aegialitis vociferа*), are regular winter visitors from the United States. May it not be that some of these waders have at some time transported seeds of the plants in question, in mud that may have adhered to their beaks

or feet? Their presence certainly seems very difficult to account for otherwise. Darwin says (Origin of Species, chapter thirteen): "I have before mentioned that earth occasionally adheres in some quantity to the feet and beaks of birds. Wading birds which frequent the muddy edges of ponds if suddenly flushed would be the most likely to have muddy feet. Birds of this order wander more than those of any other, and they are occasionally found on the most remote and barren islands of the open ocean; they would not be likely to alight on the surface of the sea, so that any dirt on their feet would not be washed off, and when gaining the land they would be sure to fly to their natural fresh-water haunts. I do not believe that botanists are aware how charged the mud of ponds is with seeds. I have tried several little experiments but will here give only the most striking case: I took in February three tablespoonfuls of mud from three different points, beneath water on the edge of a little pond; this mud when dried weighed only 6¾ ounces; I kept it covered up in my study for six months, pulling up and counting each plant as it grew; the plants were of many kinds and were altogether 537 in number and yet the viscid mud was all contained in a breakfast cup! Considering these facts, I think it would be an inexplicable circumstance if water birds did not transport the seeds of fresh-water plants to unstocked ponds and streams situated at very distant points." The plants mentioned above are not water plants, it is true, but they are common in moist soil in the vicinity of ponds.

The seeds of *Pluchea* may owe their transportation to the wind. But whatever the means of dissemination, the fact seems established that, although the bulk of the Bahama flora has probably come from the south, there is a contingent, in the northern islands of the group at least, that owes its origin to the north. It is worthy of note in this connection that in a number of cases, when our plants were compared with large series of both Florida and Cuban specimens, they were found to resemble most closely the Florida specimens; hence when species occur in both Cuba and Florida, it may well be that the Bahaman plants owe their origin to the latter.

DISTRIBUTION WITHIN THE BAHAMAN GROUP

| | |
|---|---|
| Species found on Andros, | 359 |
| " " " New Providence, | 262 |
| " common to both islands, | 153 |
| Found also on Eleuthera, | 98 |
| " " " Cat Island, | 79 |
| " " " Crooked and Fortune Islands, | 79 |
| " " " Inagua, | 88 |
| " " " Watlings, | 18 |

(The above data for plants reported from the islands other than New Providence and Andros were taken from Hitchcock's Report.)

In addition to the plants collected by us in New Providence and Andros, Professor Hitchcock lists in his report 148 more, collected from the various islands of the group. Of these 36 are grasses and 30 are widely distributed or introduced species, while *Epidendrum altissimum*, *Mimosa Bahamensis*, *Croton Eleuteria*, *Croton Hjalmarsonii*, *Pavonia Bahamensis* and *Eragrostis Bahamensis* are endemic, making a total of forty endemic species in the Bahama Islands. The last two had been previously undescribed.

NOTES ON THE LOCAL DISTRIBUTION

The Bahama pine (*Pinus Bahamensis*), so abundant on New Providence and Andros, is confined entirely to the northern islands of the group, being found in addition only on Abaco, Bahama and the Berry Islands, the first two being on the Little Bahama Bank and the latter a series of small cays on the Great Bahama Bank north of Andros.

Although, as we have seen, New Providence and Andros have many plants in common, some interesting points of difference were noted. The numerous introduced plants so common about Nassau, as *Argemone Mexicana*, *Asclepias Curassavica*, *Abrus precatorius*, *Bidens leucantha*, *Ageratum conyzoides*, etc., were of course entirely wanting on Andros but, on the other hand, Aristolochiaceae, Cactaceae, Polygalaceae, and Loranthaceae were not seen on New Providence while represented by two or three species each on Andros. *Passiflora pectinata*, while very common in the pines on Andros (also reported from Turk's Island by Grisebach), was not found on New Providence, as was also the case with

*Hymenocallis arenicola*, the latter growing luxuriantly on many of the sandy beaches of the former island.

Among the interesting plants found on Andros that have not been reported from New Providence are the following: *Agave rigida*, *Casearia laetioides*, *Pithecolobium Hystrix*, *Peltophorum adnatum*, *Ichthyomethia Piscipula*, *Euphorbia cassythoides*, *Lucuma pauciflora*, *Voyria Mexicana*, *Ipomoea repanda*, *Petitia Domingensis*, *Vitex ilicifolia*, *Mimusops Floridana* and *Morinda Royoc.* With very few exceptions the plants found on the savannas of Andros were wanting on New Providence and as they formed the most interesting feature of the Andros flora, it may be worth while to give the full list of plants found there. They were *Sabbatia campanulata*, *Eustoma exaltatum*, *Bletia verecunda*, *Euphorbia buxifolia*, *Dichromena colorata*, *Cladium Jamaicense*, *Merosphaerum pectinatum*, *Gyrostachys tortilis*, *Flaveria linearis*, *Hypoxis juncea*, *Mitreola sessilifolia* and *M. petiolata*, *Pinguicula pumila*, *Buchnera elongata*, *Gerardia purpurea* and *G. maritima*, *Polygala Boykinii* and *P. brizoides*, *Samolus ebracteatus*, *Limodorum tuberosum*, *Aletris bracteata*, *Chiococca alba parviflora*, *Buxus Bahamensis*, *Heliotropium nanum*, *Crassopetalum coriaceum*, *Rhamnidium punctatum*, and *Terminalia spinosa.* Of these only the first six were found on New Providence and in addition to *Rhamnidium punctatum*, were the only ones found on Andros elsewhere than the savannas.

On Andros itself, no Cactaceae were found in the northern part of the island, while *Cereus Swartzii* and two species of *Opuntia* were quite common in the southern part, as they are said to be on the more southerly islands of the group. We also noticed that, whereas *Vitis alata* was very common on the northern half of the island, below that it was replaced by the allied species *Vitis trifoliata.*

On both islands mosses, lichens, and fungi were noticeably infrequent, and of the few species of each that were found none were common.

# GENERIC INDEX

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## ERRATA

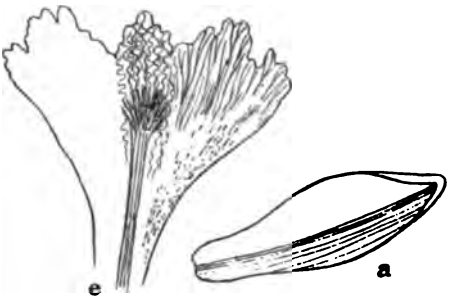
Page 10, line 7 from bottom : *dele Rhamnidium.*
Page 43, line 3 : for Wr. read Wright.
Page 48, line 1 : for Wr. read Wright.
Page 48, lines 4, 10, and 24 : for Crassopetalum read Crossopetalum.
Page 58 line 2 from bottom : for *barbata* read *barbatum.*
Page 69, line 17 : for Gris. read Griseb.
Page 77, line 17 : for lanceolata read lanceolatum.

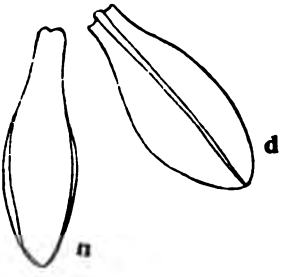
ALETRIS BRACTEATA

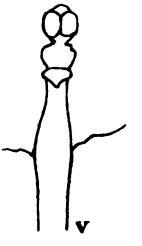
HELIOTYPE CO., BOSTON.

HYMENOCALLIS ARENICOLA

HELIOTYPE CO., BOSTON.

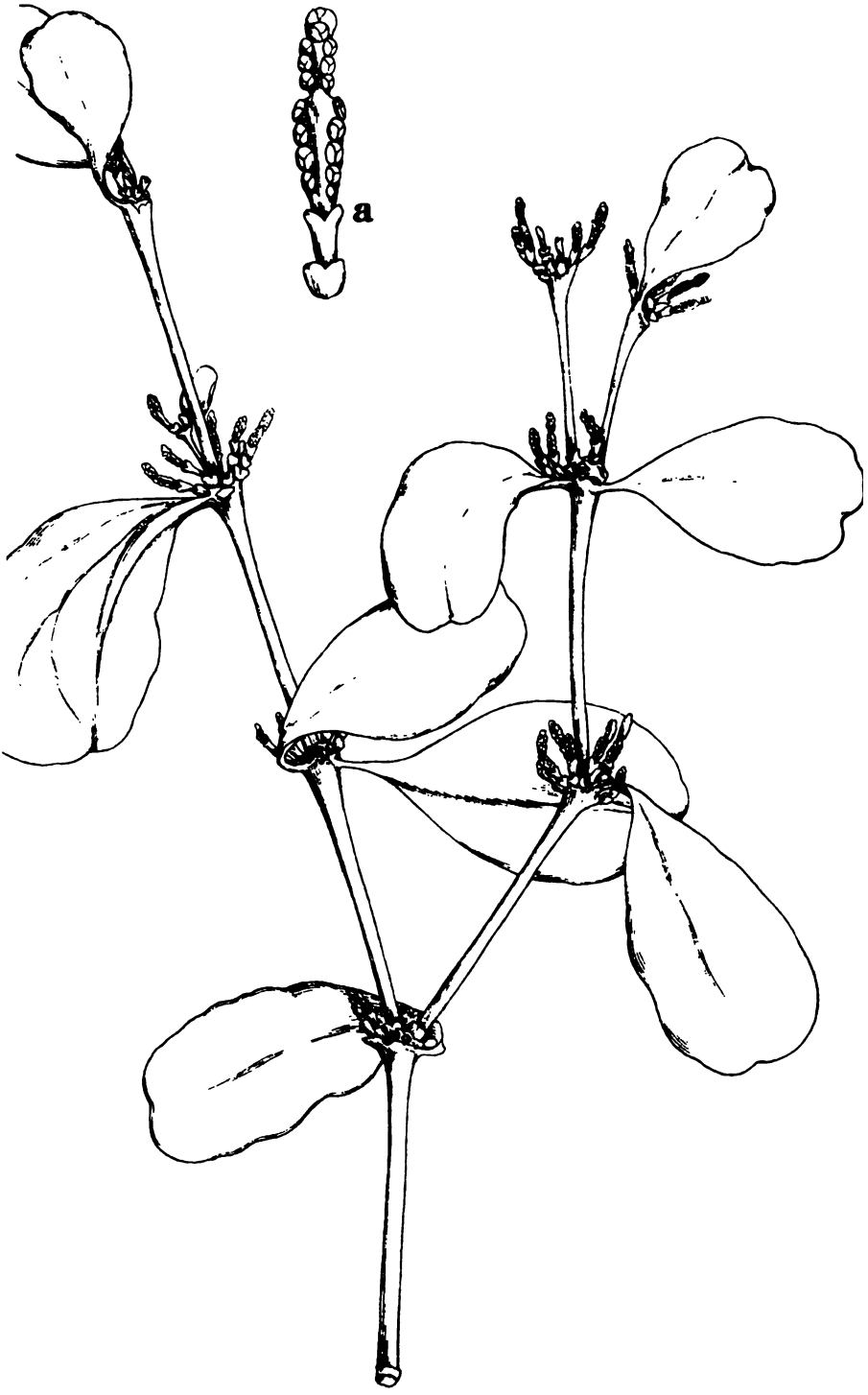





VANILLA ARTICULATA

HELIOTYPE CO., BOSTON.




*PHORADENDRON* NORTHROPIAE

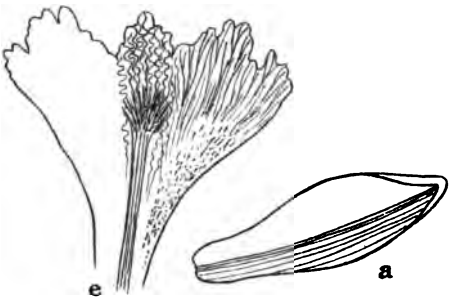
HELIOTYPE CO., BOSTON.

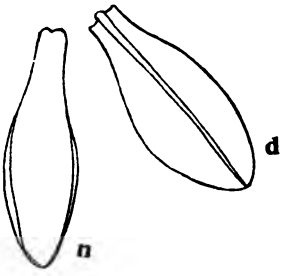
ALETRIS BRACTEATA

HELIOTYPE CO., BOSTON.

*PITHECOLOBIUM BAHAMENSE*

HELIOTYPE CO., BOSTON.



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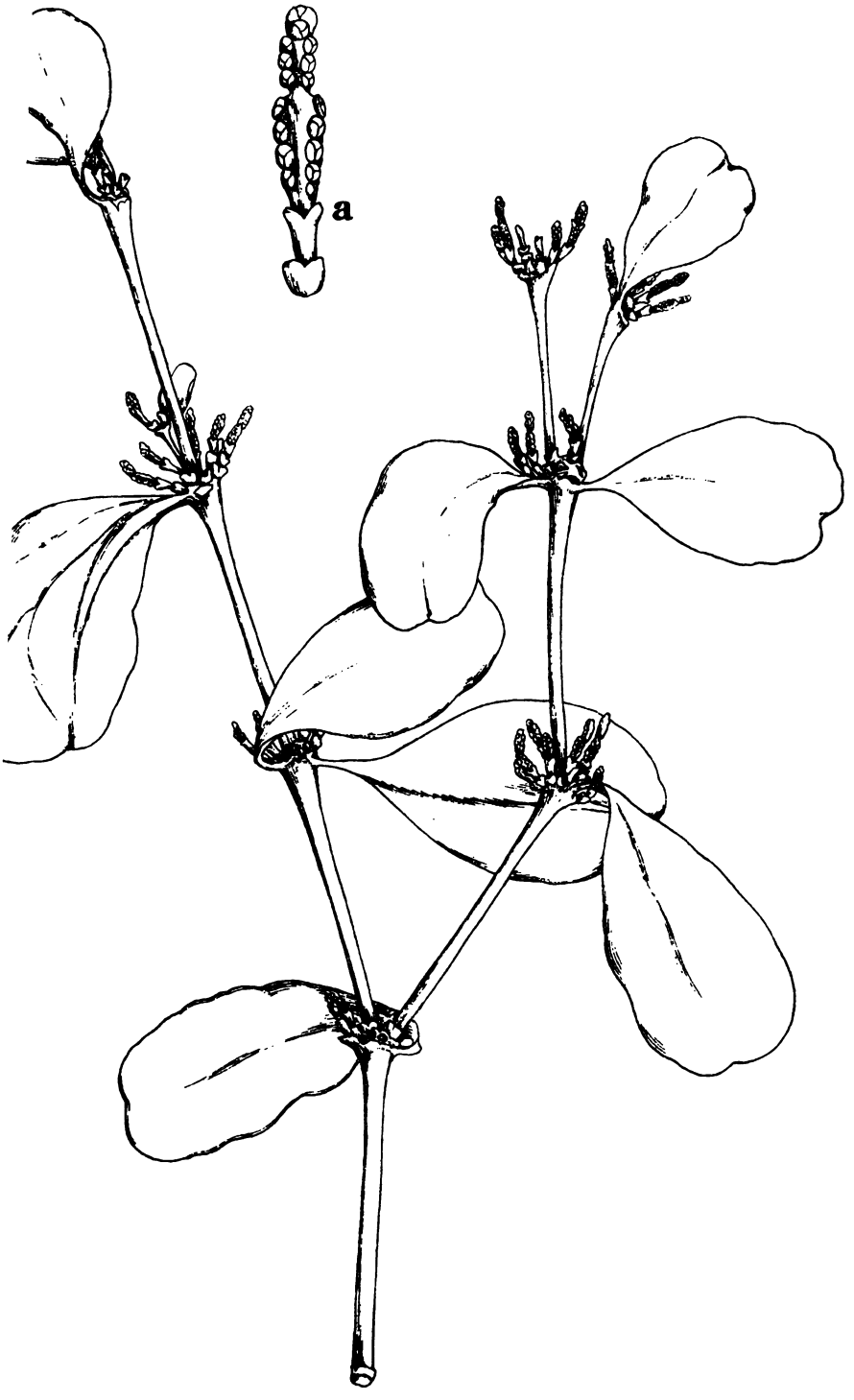



PHORADENDRON NORTHROPIAE

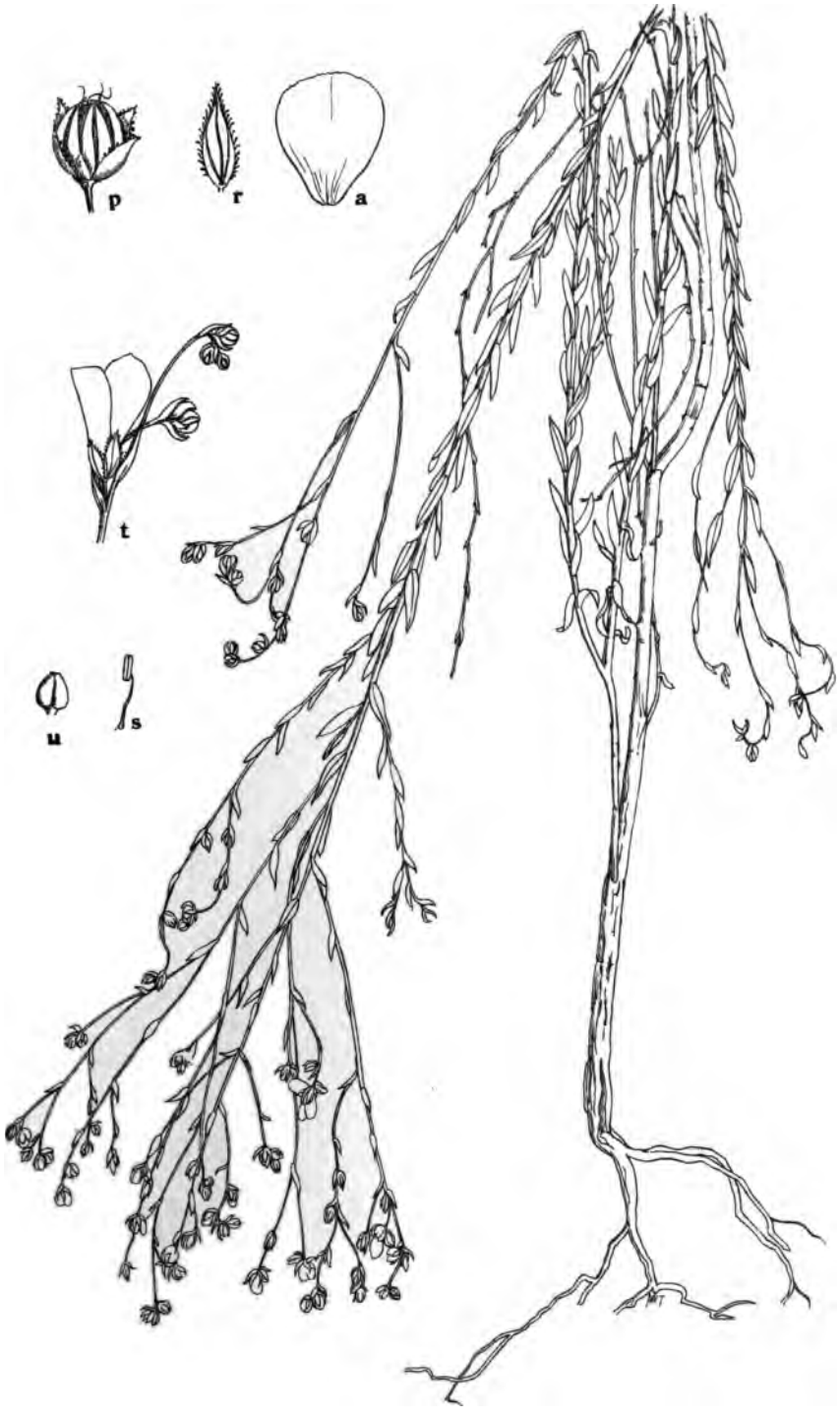
HELIOTYPE CO., BOSTON.

PITHECOLOBIUM BAHAMENSE

HELIOTYPE CO., BOSTON.

ERYTHROXYLON RETICULATUM

HELIOTYPE CO., BOSTON.




LINUM BAHAMENSE

HELIOTYPE CO., BOSTON.

REYNOSIA NORTHROPIANA URBAN

HELIOTYPE CO., BOSTON.

CROSSOPETALUM CORIACEUM

HELIOTYPE CO., BOSTON.

REYNOSIA NORTHROPIANA URBAN

HELIOTYPE CO., BOSTON.

HELICTERES SPIRALIS

HELIOTYPE CO., BOSTON.

METASTELMA BARBATA

HELIOTYPE CO., BOSTON.

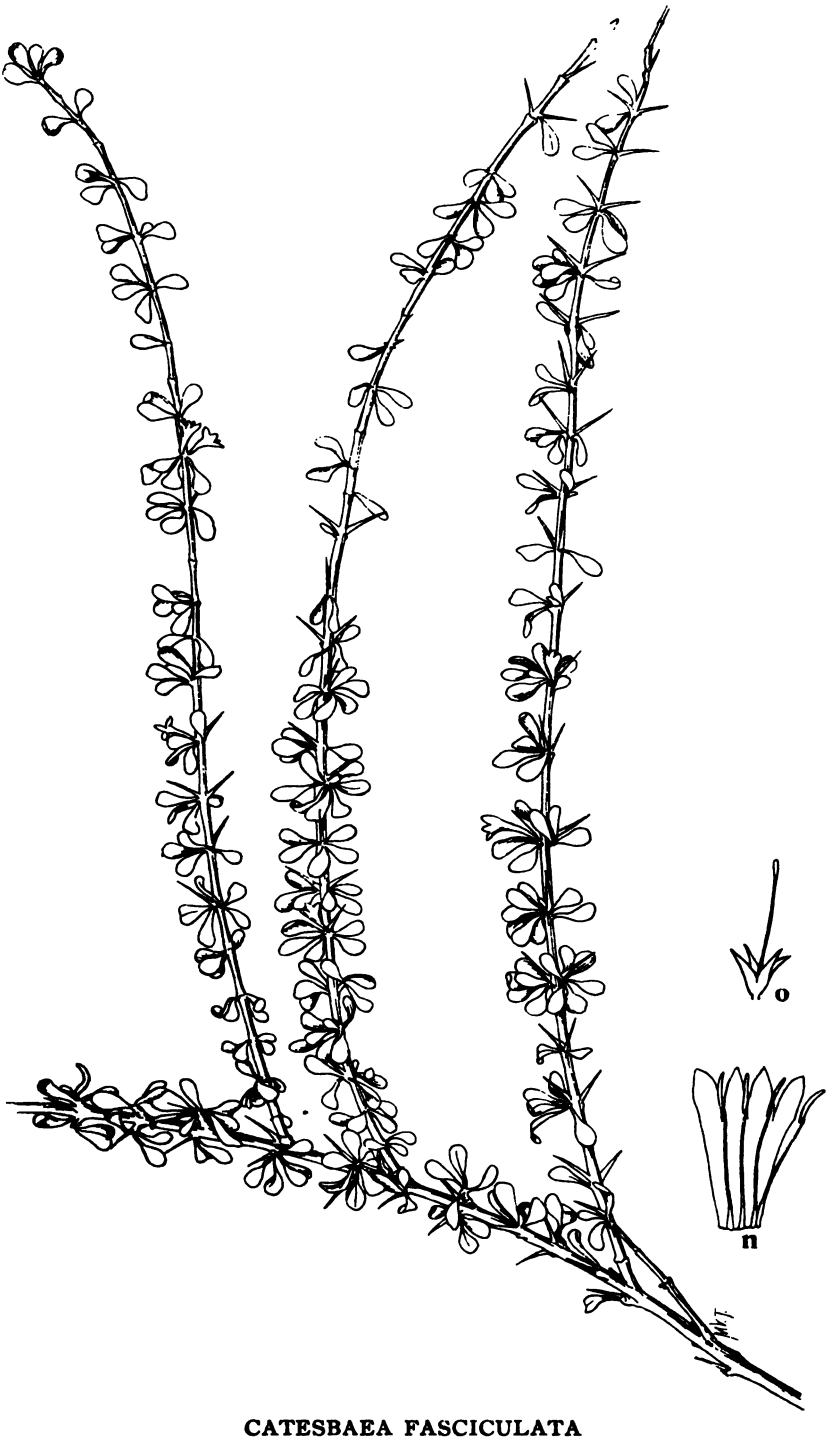
TERMINALIA SPINOSA

HELIOTYPE CO., BOSTON.

CATESBAEA FASCICULATA

TECOMA BAHAMENSIS

HELIOTYPE CO., BOSTON.




CATESBAEA FASCICULATA

HELIOTYPE CO., BOSTON.

MYRSTIPHYLLUM LIGUSTRIFOLIUM

HELIOTYPE CO., BOSTON.

ANGURIA KEITHII

HELIOTYPE CO., BOSTON.

EUPATORIUM BAHAMENSE

HELIOTYPE CO., BOSTON.

MEMOIRS

OF THE

TORREY BOTANICAL CLUB

VOL. XII NO. 2

# A CONTRIBUTION TO A REVISION OF THE NORTH AMERICAN HYDNACEAE

BY

HOWARD JAMES BANKER

ISSUED 13 JUNE 1906

# A contribution to a revision of the North American Hydnaceae

HOWARD JAMES BANKER

The following paper is intended to include a revision of all the pileate forms of the family of the Hydnaceae which have been found on the continent of North America and its adjacent islands north of the Isthmus of Panama. A few resupinate forms have been included by reason of their close relationship to pileate forms, but in general they have been excluded. The reason for this arbitrary limitation of the scope of the work is the impossibility of adequately treating the resupinate forms and referring them to their proper species until such time as the Berkeley types can be thoroughly examined by one familiar with our American plants.

The Hydnaceae represent one of the smaller families of the Basidiomycetes, there being not more than five hundred known species in the family, and of these not more than two hundred have been reported within the geographical limits of this paper. With a few exceptions the species are not common and generally appear to be quite local in distribution. The task, therefore, of getting suitable material on which to base a revision of the family has proved more difficult than was at first anticipated. Nor are the herbaria of collectors as helpful as one would have a right to expect. The published descriptions of species of this family are frequently incomplete and inadequate to fully discriminate the species, so that it is possible often to include several different species under the one description. Collectors are inclined to refer specimens according to some conspicuous feature, such as a scaly pileus or a zonate pileus, and then pay little attention to other apparently minor characters. Owing to the local character of the distribution of these plants, combined with the comparative rarity with which they are found, few discover that the plants which they referring to a given species are very different from the plants

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which others are referring to the same species. Moreover, assuming that the species is common and well known, no field notes are considered necessary. As a result much confusion has arisen in our conception of these species. Occasionally mycologists, who have received specimens from all parts of the country, have noted that certain species present remarkable variations, but as the material thus received is usually fragmentary, without suitable notes, and is received only at rare intervals, they have generally contented themselves with noting that the form is an unusual one.

In the extensive collections of the New York Botanical Garden, brought together from very many different sources, the confusion in species is very evident. This is conspicuously seen in the forms referred to *Hydnum imbricatum* L. and *H. zonatum* Batsch. As to the former species, nearly everything with a scaly pileus has been referred to it, while the latter has been made to include almost everything with a zonate pileus.

While herbarium specimens often clearly show that they represent distinct species, so great is the change that these plants undergo in the process of drying that one rarely feels justified in attempting a description of new species from such material without satisfactory field notes. On the other hand the securing of fresh material or at least of ample and accurate field notes is a difficult and discouraging task. During six years of careful watching for specimens of the *H. imbricatum* allies, it has been the writer's fortune to find but two of the scaly-capped forms in the field; likewise but one of the forms commonly referred to *H. zonatum* has come within his observation. Of more than forty specimens found in the herbaria referred to these two species, not one was accompanied by descriptive notes that were of any value. Yet we have at least a half dozen good species here represented, could the distinctive characters be clearly established.

The species of this family are not only comparatively rare and local in distribution but they are often intermittent in appearance. The writer once found three different species in a space not over ten feet square, and a fourth in the same woods a short distance away. But not one of the four was found anywhere in that region in the next four successive years, although the ground was searched over repeatedly each year.

## DISTRIBUTION

The geographical distribution of these plants appears to be largely influenced by latitude. But collections of basidiomycetous fungi from the region west of the Mississippi river have been so few and incomplete that general conclusions respecting distribution in this region can not be confidently drawn. The following areas may be recognized as possessing each a characteristic and somewhat distinctive hydnaceous flora. (1) The northeastern United States south to North Carolina and Tennessee and west to the Great Plains. (2) The Southern States west to Louisiana. (3) The Gulf region including the West Indies and the immediate borders of the Gulf. (4) The north Pacific Coast including Oregon and Washington. It seems probable that Canada and northern New England to Greenland may represent another distinct floral distribution, but collections in this region have been too meager to suggest more than a possibility. These remarks on distribution are based on specimens actually seen by the writer and do not include the various species reported in catalogues and local floras without accompanying specimens. The material examined has come chiefly from the following states: Maine, Massachusetts, Connecticut, New York, New Jersey, West Virginia, Ohio, Indiana, Kentucky, Alabama, Louisiana, Cuba, Honduras, Oregon, Washington. It will be seen therefore, that there are large areas of the country that have been scarcely explored for members of this group of plants. Even in the states quoted the collections are often from one or two localities only; thus Maine is represented only by collections at Orono and Mt. Desert, Ohio by collections in the Miami Valley, Indiana by work in the vicinity of Greencastle, and Alabama by collections made near Auburn. This study of distribution cannot be satisfactorily supplemented by published local floras, for in consequence of the confused conception of species in this family such lists are wholly unreliable except when verified by actual specimens and these are often lacking. A comparison of two collections on which such floras have been based, quickly reveals how utterly untrustworthy are these lists of species as a means of determining distribution. The plants referred to *Hydnum imbricatum* by Alabama collectors are totally distinct from the plant referred to the same species by the

New England botanists. Professor Earle has noted that *Hydnum repandum* as collected by him in Connecticut was a very different thing from the plant of that alliance with which he had been acquainted in Alabama.

It is hoped that the present contribution may lead to a clearer conception respecting the species of this family and be a means of stimulating a more exact study of the distribution of these plants. It can hardly be expected that all confusion has been removed or that all errors have been avoided. The source of many of our present difficulties is to be traced back to the work of early European botanists, whose material is either inaccessible or has long since passed into an irrecoverable oblivion. The author believes that in the majority of cases, with respect to the species included in this paper, he has formed a clear conception of them in his own mind and has endeavored to present that conception as definitely and distinctly as he was able in the accompanying descriptions and synopses. Whether he has in all cases made an absolutely correct determination, especially in the case of species referred to old European types, he cannot state with complete confidence.

## NOMENCLATURE

In the determination of questions of nomenclature we have conformed closely to the Philadelphia code.* There is a case of a peculiar character, however, which needs some further comment. In 1878 M. C. Cooke and L. Quélet published together a *Clavis Synoptica Hymenomycetum Europaeorum.* This work was based upon Fries' *Hymenomycetes Europaei* and followed his classification. In connection with the subgroups of the genus *Hydnum* there were published in parentheses the generic names *Sarcodon*, *Calodon*, *Pleurodon*, and *Dryodon* ascribed to Quélet. It has been customary among botanists to regard this work as the place of origin of Quélet's genera. But the names of the species in each group were not made to agree in gender with these names but continued in agreement with *Hydnum* which was printed as the name of the genus. There were, therefore, no binomial combinations of these genera published in this work and hence the genera were not published according to our accepted rules.

* *Cf.* Bull. Torrey Club 31 : 249.

While in general it is not difficult to decide to what groups of species Quélet intended his generic names to apply, the name *Sarcodon* is so placed as to be made to include also the next genus *Calodon*. The whole work is nomenclatorially unfortunate and sets at defiance all system or rules of publication. It cannot, however, be ignored, for later writers including Quélet himself have taken up these names and treated them as established genera. In 1881 P. A. Karsten in an *Enumeratio Hydnearum Fr. Fenicarum, Systemate novo dispositarum*, published in the Revue Mycologique $3^1$: 19, recognized Quélet's genera and republished them with species properly assigned under each, in so doing setting aside his own genera *Auriscalpium*, *Hydnellum* and *Friesites* published in 1879, in recognition of Quélet's priority. This paper of Karsten thus becomes technically the place of publication of the genera *Sarcodon*, *Calodon*, *Dryodon* and *Pleurodon* of Quélet.

The correct citation, therefore, of these genera with their types s as follows :

*Dryodon* Quél.; Karst. Rev. Myc. $3^1$: 19. 1881.
*D. coralloides* (Scop.) Karst.

*Sarcodon* Quél.; Karst. Rev. Myc. $3^1$: 20. 1881.
*S. imbricatus* (L.) Karst.

*Calodon* Quél.; Karst. Rev. Myc. $3^1$: 20. 1881.
*C. suaveolens* (Scop.) Karst.

*Pleurodon* Quél.; Karst. Rev. Myc. $3^1$: 20. 1881.
*P. auriscalpium* (L.) Karst.

Three of the above genera as thus determined becomes synoyms as follows :

*Dryodon* = *Hericium* Pers.
*Calodon* = *Hydnellum* Karst.
*Pleurodon* = *Auriscalpium* S. F. Gray.

**Synopsis of Genera**

eeth evident, averaging 0.5 mm. or more in length, more or less awl-shaped, sometimes compressed.

Spores smooth, white or hyaline ; plants usually light-colored, white to reddish or gray.

Plants mesopodous, terrestrial, fleshy, white, red or yellow. 1. *Hydnum*.

Plants not mesopodous, epixylous.

Plant body more or less tuberculiform or branched, the branches subterete or angular, fleshy or subfleshy, white to reddish or yellowish. 2. *Hericium.*

Plant body not tuberculiform, usually dimidiate to subresupinate, often confluent-imbricate, if branched the branches flattened or flabellate.

Hymenium smooth; plants tough to subfleshy, white or ochraceous to gray. 3. *Steccherinum.*

Hymenium with cystidia; plants hard, woody, reddish. 4. *Echinodontium.*

Spores roughened; plants commonly dark colored, usually terrestrial.

Spores coarsely tuberculate, colored (pale in *H. reticulatum*); plants usually mesopodous and dark colored.

Plants fleshy, brittle. 5. *Sarcodon.*

Plants fibrous, tough. 6. *Hydnellum.*

Spores minutely papillose or echinulate, white or hyaline; plants usually tough, fibrous.

Spores echinulate; plants mesopodous, often light colored. 7. *Phellodon.*

Spores papillose; plants sessile or with a lateral stipe, dark colored at least with age.

Plant body of branched processes, sessile or resupinate. 8. *Leaia.*

Plant body normally pileate, stipitate; stipe lateral. 9. *Auriscalpium.*

Teeth minute, less than 0.25 mm. in length; plant body pileate, thin, subsessile. 10. *Grandinioides.*

The above synopsis, it will be observed, is based primarily on spore characters. While this is not a convenient basis for practical field work especially as in some cases a one twelfth oil-immersion is found necessary to make out the spore markings, yet these characters appear to be very definite and fundamental in the separation of genera, and have, therefore, been employed. Other and more evident characters have been added as fully as possible but it must be borne in mind that these are subject to many exceptions or at least modifications.

## 1. HYDNUM L. Sp. Pl. 2: 1178. 1753

*Sistotrema* Persoon, Neues Mag. für die Bot. 1: 108. 1794.
*Hypothele* Paulet, Icon. des Champ. *pl. 35.* 1800?
*Dentinum* S. F. Gray, Nat. Arr. Brit. Pl. 1: 650. 1821.
*Tyrodon* Karsten, Rev. Myc. $3^1$: 19. 1881.

Plants terrestrial, mesopodous, medium to small size, less than 10 cm. wide, light colored (white or shades of yellow and red), never tomentose, sometimes pubescent; substance fleshy, usually

brittle when fresh; teeth pale yellowish or reddish, often white when young, terete or flattened; spores white or yellowish, oblong, ovoid or subglobose, often more or less angular, usually smooth, often apiculate, generally with one or more small guttulae.

*Hydnum repandum* is probably the oldest and most commonly known, as well as the most widely spread, species of the family. It is altogether probable that it is the plant referred to by Bauhin, *Historiae Plantarum Universalis* 3: 828. 1651. It is also undoubtedly the plant figured and described by Dillenius, *Catalogus Plantarum circa Gissam nascentium*, 188, *pl. 1.* 1719, upon which he founded the genus *Erinaceus*, the prototype of *Hydnum*. When, in 1753, Linnaeus adopted his binomial system of nomenclature, this species, although not placed first in his list, represents the nomenclatorial type of his genus *Hydnum*, according to the interpretation of the principle of generic types by the code here followed.

*Hypothele* Paulet was the first genus actually carved out of the Linnaean *Hydnum*, but was founded on the same type, *H. repandum* L. Paulet's original work* does not appear to have had a very wide distribution or to have been very generally known; not until after its republication by Leveille in 1855 do we find the European mycologists apparently acquainted with it. In 1821 S. F. Gray, in his Natural Arrangement of British Plants 1: 650, evidently unaware of the work of Paulet, founded the genus *Dentinum* on *H. repandum* L. and *H. rufescens* Pers., making an exact duplicate of *Hypothele* Paulet. Gray's work, following as it did the natural system of Jussieu, did not meet with an enthusiastic reception by his fellow-countrymen, and thus failed to receive the recognition and circulation that it deserved, so that as late as 1881 Karsten, in the Revue Mycologique 3[1]: 19, apparently ignorant of the work both of Paulet and of Gray, separated the species *H. repandum* L. and *H. rufescens* Pers. again as a genus and gave to it the name *Tyrodon*. The plants thus distingished stand in marked contrast with other members of the family and seem to fully justify the opinion of these three eminent botanists who so

* The text of Paulet's Icones des Champignons was published in 1793 but does not contain a reference to *Hypothele*. This name appears only on the plate cited. The plates were issued later than the text in a series of fascicles, the last twelve of which appeared after Paulet's death, which occurred in 1826.

curiously concurred in regarding them as constituting a distinct genus.

The genus *Sistotrema* was established by Persoon on *S. confluens* as the type. The only character by which this genus appears to be separated from *Hydnum* is that of the flattened teeth, and considering that this character is frequently present in *H. repandum*, it seems to be a wholly insufficient ground for the separation of the genus. This generic name is older than *Hypothele*.

**Synopsis of the Species**

Spores small, less than 6 $\mu$ in diameter; the entire plant generally white to cream colored.
- Pileus viscid, at least when young, as shown by adhering leaves.
  - Plants large, 5–13 cm. wide, not confluent; stem stout; pileus not deeply depressed. 1. *H. albo-magnum.*
  - Plants small, less than 3 cm. wide, confluent; stem slender; pileus more or less infundibuliform. 6. *H. sublamellosum.*
- Pileus dry; plant small, less than 6 cm. wide, turning yellow to brown when cut or bruised. 2. *H. albidum.*

Spores large, more than 6 $\mu$ in diameter; plant yellowish buff or reddish.
- Plants turning yellow when cut or bruised, generally caespitose; stem as long as the width of the pileus. 4. *H. caespitosum.*
- Plants not turning yellow when bruised, solitary or gregarious, rarely caespitose; stems usually shorter than the width of the pileus.
  - Teeth decurrent half way down the stem; substance somewhat tough. 5. *H. washingtonianum.*
  - Teeth scarcely decurrent; flesh brittle. 3. *H. repandum.*

1. HYDNUM ALBO-MAGNUM Banker, Bull. Torrey Club **28**: 207. 1901

A low, broad, fleshy plant usually pure white throughout though sometimes lightly tinted, turning yellowish in drying. Pileus uneven, repand, viscid when young, probably subglabrous in age, reaching 10 cm. or more in width; flesh white, brittle, and mealy; stem short, thick, central, or excentric, often with bulbous base, its length not more than half the width of the pileus, the plant often appearing nearly sessile; teeth white, slender, crowded, about 3 to one millimeter, acute almost bristle pointed, 2–4 mm. long, subdecurrent; spores white or hyaline, oblong-ovate, obliquely apiculate, smooth, with one or more small guttulae, small, 3.5–4 by 5.5–7 $\mu$; taste mild, somewhat mealy.

HAB.: In mixed woods. Nov.–Jan.

RANGE: Alabama, *Earle*.

The plant appears to have chiefly a southern distribution but may have a wider range than is supposed as it is likely to be passed over by collectors for *H. repanda*. It has not been reported as yet outside of the type locality where it is not common. The original description was made from dried specimens, which without ample field notes are always unsatisfactory in the case of fleshy fungi. The description is now corrected and supplemented by the excellent field notes since received from Professor Earle.

2. HYDNUM ALBIDUM Peck, Bull. N. Y. State Mus. Nat. Hist. 1 : 10. 1887

Plant terrestrial, mesopodous, white to cream-colored, staining brown when injured, 2–5 cm. high ; pileus nearly plane or slightly convex or depressed, more or less irregular, margin thin ; surface "subpruinose" from "felted fibrils," dry, 2–8 cm. wide ; substance fleshy-fibrous, brittle, becoming mealy, white turning reddish or brownish when injured ; stem slender, terete, even, enlarging to a subbulbous base, more or less excentric, widening into the pileus, solid, concolorous, 2–5 cm. long by 0.5–1 cm. wide ; teeth white staining brownish, slender, terete, tapering, acute to "bristle tipped," subdecurrent, crowded, about 3 to one millimeter, 1.5–3 mm. long by 0.15–0.25 mm. wide, shorter toward stem and margin ; spores white or hyaline, subglobose to subpyriform, smooth, 3.5–5.5 $\mu$ wide ; taste mild at first, afterwards becoming slightly acrid.

HAB.: In mixed woods. Aug.–Nov.

RANGE : New York, *Peck, Peck & Earle 817, Underwood, Banker 713 ;* Connecticut, *Earle 1310, Underwood & Earle 1202*

ICON : Peck, Rept. N. Y. State Mus. Nat. Hist. 51 : *pl. 56. f. 1–7.*

The plant as thus far reported is northeastern in its distribution. The New York collections have all been east of the Hudson. The plant has also been reported from Vermont, *Burt*, but I have not seen his specimens.

Peck does not mention in his description that the flesh turns yellow or brown when bruised, but specimens found by the writer in New York and by Underwood and Earle in Connecticut while in all other respects answering to Peck's plants showed also this characteristic. I have usually found this plant in very wet ground.

3. HYDNUM REPANDUM L. Sp. Pl. 2: 1178. 1753

*Hydnum rufescens* Schaeffer, Fung. Bav. et Pal. Icon. 4: 95. *pl. 141.* 1774.

*Hydnum flavidum* Schaeffer, *op. cit.* 4: 99. *pl. 318.* 1774.

*Hypothele repanda* Paulet Icon. Champ. 2: 126. *pl. 35. f. 1, 2.* 1800?

*Dentinum repandum* S. F. Gray, Nat. Arr. Brit. Pl. 1: 650. 1821.

*Tyrodon repandus* Karsten, Rev. Myc. 3[1]: 19. 1881.

*Hydnum umbilicatum* Peck, Bull. N. Y. State Mus. 10: 953. *pl. K. f. 14–18.* 1902.

Plant terrestrial, mesopodous, cream-colored to tawny or reddish, medium size to small, 1–9 cm. high, more or less gregarious; pileus convex to depressed, occasionally subinfundibuliform, generally uneven, irregular, 1–12 cm. wide; margin repand, sometimes fluted, fertile; surface subpubescent to pruinose or nearly smooth, sometimes cracked towards the center into thick scales, pale buff to reddish buff, usually darker towards the center; substance fleshy, brittle, subfibrous becoming mealy, white; stem stout to slender, bulbous at base, subcylindrical, sometimes curved or inclined, somewhat excentric, surface smooth or subpruinose, usually paler than the pileus but sometimes darker, solid, 2.5–6 cm. long, 0.5–2.5 cm. thick; teeth coarse, straight, terete to flattened, acute or fimbriate tipped, scarcely decurrent as granules, 1–6 mm. long by 1 mm. wide, when flattened sometimes 4 mm. broad, white or cream colored; spores subglobose to subpyriform, usually apiculate, guttulate, 6–9 $\mu$ wide, white; taste at first mild, then slightly acrid.

HAB.: In mixed woods. July–Jan.

RANGE: Maine, *Harvey, White;* Massachusetts, *Underwood;* Connecticut, *Underwood 837, 813, etc., Earle 462;* New York, *Underwood, Zabriskie, Peck, E. C. Howe, Fischer, Banker;* New Jersey, *Ellis;* Pennsylvania, *Schweinitz;* Virginia, *Murrill;* West Virginia, *Nuttall;* Alabama, *Earle, Baker.* It has also been reported from North Carolina, *Schweinitz;* South Carolina, *Curtis;* Kentucky and Ohio, *Morgan;* and California, *Harkness & Moore.*

ICON.: Atkinson, Mushrooms Edible Poisonous, etc., 2d Ed. *pl. 78;* Barla, L'Champ. de l'Prov. de Nice *pl. 39. f. 1–9;* Bulliard, Herbier de la France *pl. 172;* Cordier, Les Champ. *pl. 43;* Fries, Sverig. ätl. svamp. *pl. 15;* Gibson, Edible Toadstools and Mushrooms, *pl. 27;* Hussey, Ill. Brit. Myc. 1: *pl. 16;* Krom-

holz, *pl. 50. f. 1–9*; Peck, Rept. N. Y. State Mus. **48**: *pl. 38*; Rept. Conn. Board Agric. **29**: *pl. 6, f. 2*; Sowerby, Eng. Fung. *pl. 176*.

Besides its unusual cosmopolitan range this species appears to possess extreme variability. Several attempts have been made to split it up into distinct species but without very great success. The following key may assist in some degree in separating the principal forms peculiar to this country and is offered as an aid to a better knowledge of this difficult aggregation.

Plants reddish buff

Plants small, averaging less than 4 cm. wide, often umbilicate, spores large, 8–10 $\mu$ wide. Form A.

Plants large, stout, reaching 12 cm. wide, average width of cap 6–8 cm.; pileus often cracked, sometimes into thick scales, deeply umbilicate, spores 7–8 $\mu$ wide. Form B.

Plants pale buff to cream-colored, slender, medium size, averaging 4–6 cm. wide, rarely 8 cm., spores 7–8 $\mu$ wide. Form C.

Form A is presumably *Hydnum umbilicatum* Peck, *loc. cit.* In all of the above forms none of the characters ascribed appear to be constant, while intermediate forms are readily found that connect them most intimately. Whether these forms can be regarded as true species or even as varieties can only be decided by a careful study of the living plants.* The extreme seasonal range of this species is due to its northern and southern distribution.

4. HYDNUM CAESPITOSUM Banning; Peck, Rept. N. Y. State Mus. **44**: 74. 1891

Plant terrestrial at base of trees and stumps, mesopodous, cespitose, yellowish, 6 cm. high; pileus convex to expanded or subplane, subregular, even, 4 cm. wide, subconfluent, margin even; surface appressed-fibrous, pale ochre, yellow, or dark flesh-colored; substance fleshy, white, turning yellow when cut; stem solid, subcylindrical, subflexuose, floccose above, subglabrous below, whitish, staining yellow when bruised, 6 cm. long by 1 cm. wide, united at the base; teeth short, conical, acute, decurrent, pale ochre or light flesh color, less than 3 mm. long, 2 or 3 to one millimeter; spores subglobose, 7 $\mu$ wide; taste mild.

* A full discussion of the variability of this species will be found in Torreya **4**: 113.

HAB.: On ground at roots of trees and near old stumps. July.

RANGE: Maryland, *Banning;* Connecticut, *Earle.*

I have not seen the the type specimens which were found by Miss Banning in Maryland. Earle's Connecticut plants differ from Miss Banning's description only in their somewhat darker color.

5. HYDNUM WASHINGTONIANUM Ell. & Everh. Proc. Phila. Acad. 1894: 323. 1894

Plants terrestrial, mesopodous, pale orange, 4 cm. high; pileus subplane, slightly depressed, thin, irregular, 4 cm. wide; surface glabrous, wrinkled when dry, pale orange; substance fleshy, "subviscose"; stem subcylindrical, tapering slightly toward the base, solid, central or slightly excentric, 3 mm. wide; teeth terete, slender, acute, decurrent half way down the stem, pale yellow nearly white when fresh, 3–5 mm. long; spores subglobose, white, 6–7 $\mu$ wide, "borne on clavate to cylindrical basidia 20–22 by 6 $\mu$, with four erect slender sporophores about 6 $\mu$ long."

HAB.: On the ground in coniferous woods. Dec.

RANGE: Washington, *Parker 214.*

Only the type specimen has been seen and the above description is based largely on the original description by Ellis.

6. HYDNUM SUBLAMELLOSUM Bulliard, Hist. des Champ. de la France. 306. 1791

*Sistotrema confluens* Persoon, Disp. Meth. Fung. in Neues Mag. für die Bot. 1: 108. 1794.

Plants terrestrial, mesopodous, gregarious, more or less confluent, pale yellow, small, 1–2 cm. high; pileus depressed or subinfundibuliform, irregular, 0.5–2 cm. wide; margin thin, repand, sterile; surface apparently glabrous or viscid (?), pale yellowish-white to orange; substance fleshy, fibrous, thin, soft when dried; stem slender, terete, attenuate downward to a bulbous base, concolorous with pileus; teeth short, compressed or flattened, often confluent and deformed forming pseudopores, decurrent, pale yellow to ochraceous, less than 1 mm. long, 3 or 4 to one millimeter; spores hyaline or white, oval or oblong, smooth, 3 by 4 $\mu$.

HAB.: On ground under conifers. Sept.–Jan.

RANGE: Alabama, *Earle, Baker;* Vermont, *Burt.*

ICON.: Bulliard, Herb. de la France, *pl. 453. f. 1.*

EXSICC.: Fautrey, Herb. Crypt. de la Cote-d'Or (France) 2282. *Rabenhorst,* Fung. Europ. 1409.

The above description was written from the dried specimens and without any field notes, and may, therefore, be inaccurate in some particulars. The plants grow among the needles of conifers which become imbedded in the pileus or adhere to the surface in a way that suggests its being probably viscid. The species has been generally known by Persoon's name. Many specimens that are referred to *Sistotrema confluens* Pers. prove to be flat toothed forms of *H. repandum* but the above collections are very distinct and answer in all particulars to Bulliard's plant. In his original description of *S. confluens* Persoon said "pileo suberoso" but in Syn. Fung. 551 he says "pileo carnoso." In other respects the descriptions are alike and the references are the same. It would seem, therefore, that the first expression was an error. Although the above collections are so widely removed from each other geographically there appears to be no question of their identity.

If we regard these plants as typical representatives of the genus *Sistotrema*, there appears to be no ground whatever for separating that genus from *Hydnum.* Karsten in the Revue Mycologique $3^1$: 19. 1881, places the genus *Sistotrema* with *Merulius* and *Phlebia* in the tribe Merulieae which he first assigned to the Hydneae and afterward to the Polyporeae. While *Phlebia* appears to be more closely related to *Merulius* than to any of the genera of the Hydnaceae, I should place it in the family Thelephoraceae, but *Sistotrema confluens* Pers. seems to be congeneric with *Hydnum repandum* in every particular except the almost constant tendency of the hymenial surface to form pores. This character, however, is not uncommon among Hydnaceae and cannot be considered in itself as a sufficient ground for even generic distinction.* In fact the separation of the families Polyporaceae and Hydnaceae on the basis of the hymenial surface in the former case consisting of pores and in the latter of teeth must be made with considerable mental reservation.

* *Cf. Hydnellum zonatum, Hydnum sublamellosum* and *Steccherinum adustum.*

SPECIES INQUIRENDA

*Hydnum diffractum* Berk. Lond. Jour. Bot. 6: 323. 1847.

This species is said to be allied to *H. repandum*. The description is too incomplete to be satisfactory. The type material as seen by Underwood was "an amorphous mass of fungous matter with no indication of teeth whatever." I have never seen anything that appeared to answer to the description,* and am strongly inclined to believe that the species represents one of the large cracked specimens of *H. repandum*.

2. HERICIUM Pers. Neues Mag. für die Bot. 1: 109. 1794

*Hericium* Fries, Syst. Orb. Veg. 88. 1825, *pro parte*.
*Medusina* Chevallier, Fl. Gen. des Env. de Paris 278. 1826.
*Friesites* Karsten, Medd. Soc. Faun. et Fl. Fenn. 5: 27. 1879
*Dryodon* Quélet; Karsten, Rev. Myc. 3[1]: 19. 1881.

Plant body branched or tuberculiform or rarely wanting, sessile or short stipatate, epixylous, parasitic or saprophytic, white or yellowish; teeth pendent, short or long; spores subglobose to oblong, smooth, white, uniguttulate, the guttula central and usually occupying half to two-thirds of the spore.

The genus, which is not the same as *Hericium* Fries, was first established by Persoon, on *Hydnum coralloides* Scop. a single species. In 1797 Persoon again published the genus with several species in his *Commentatio de Fungis Clavaeformibus*. In 1821, Fries, Syst. Myc. 1: 408, placed the species in the third tribe of the genus *Hydnum* namely *Merisma*. He divided the group into two subtribes: *Genuina* which included *H. coralloides* and *H. clathroides*; and *Gomphi* which included *H. Caput-Medusae*, *H. hystrix* *H. echinus* and *H. ramaria*. Later in 1825, *op. cit.*, Fries raised the subtribe *Gomphi* to generic rank and gave it the name *Hericium* but expressly declared it was not to be confused with *Hericium* Pers. the type of which he asserted was *H. coralloides*. Why, therefore, Fries should have used *Hericium* as the name of his new genus at all can only be understood as revealing the loose nomenclatural methods then in use. Unfortunately the weight of Fries' influence gave a stability to his genus that its intrinsic value could not

* *Cf.* Bull. Torrey Club 28: 207 for further discussion and a copy of the original description of this species.

command and Persoon's earlier work was forgotten. Afterward Fries, Epic. 511, removed from his genus *H. caput-Medusae* and *H. ramaria* and remanded them back to their association with *H. coralloides* in the tribe *Merisma* of his genus *Hydnum*. Fries considered the possibility of regarding the group thus brought together as a distinct genus but abandoned it. In 1878 Quélet in the *Clavis Hymenomycetes* published by himself in association with Cooke, suggested treating the tribe *Merisma* of Fries as a group of generic rank and proposed the name *Dryodon* for it but failed to establish the genus according to modern criteria. The next year Karsten, not knowing of Quélet's suggestion, established the genus *Friesites* for substantially the same group.* But in 1881, having in the meantime seen the *Clavis Hymenomycetes* of Cooke and Quélet, he took up the name *Dryodon* suggested by Quélet and substituted it for his own *Friesites* thus giving the genus *Dryodon* a proper publication. By the latter name the group has generally been known when it has been recognized. At an earlier date, however, Chevallier, 1826, established the genus *Medusina* on two species, *M. patula* = *Hericium Erinaceus* (Bull.) and *H. coralloides* (Scop.). The law of priority requires that we should reinstate the older *Hericium* of Persoon.

**Synopsis of Species**

Pileus distinctly branched or tuberculiform, light-colored, whitish at least when young.
  Pileus more or less branched to the base.
    Teeth covering the underside of all branches even to the base.
      1. *H. laciniatum*.
    Teeth chiefly on the ultimate branches, usually long and pendent.
      2. *H. coralloides*.
  Plant more or less massive or tuberculous.
    Plant tuberculous; teeth pendent directly from the body. 4. *H. Erinaceus*.
    Plant subtuberculous; teeth pendent from short peripheral branches.
      3. *H. caput-ursi*.
Pileus a resupinate subiculum of concrescent tubercles or wanting, ochraceous to buff.
  Plant of many coalescent tubercles with pendent teeth, yellow to orange.
    Spores oval 3.6 by 5.5 $\mu$, teeth compressed or terete, often branching.
      5. *H. croceum*.
    Spores oblong curved, 2.7 by 4.5 $\mu$; teeth flattened, fimbriate, simple.
      6. *H. fimbriatum*.
  Plant consisting of a single fascicle of teeth with little or no subiculum, whitish.
    7. *H. fasciculare*.

* It is unfortunate that this circumstance should thus render it impossible that the greatest of mycologists should have the one genus dedicated to his honor which tradition asserts was the inspiration to his life work.

### 1. **Hericium laciniatum** (Leers)

*Hydnum laciniatum* Leers, Fl. Herb. 2d. ed. 280. 1789.*

*Hydnum ramosum* Bulliard, Hist. de Champ. de la France, 305. *pl. 390.* 1791.

*Hydnum abietinum* Schrader, Spic. Fl. Germ. 181. 1794.

*Medusina coralloides* Chevellier, Fl. Gen. des Env. de Paris 1: 279. 1826, in part?

Plants gregarious, epixylous, branched from a single short or scarcely evident stipe, shining white throughout, becoming brownish with age, the whole mass 6–20 cm. wide; stipe usually imbedded in the substratum, 1–3 cm. wide, immediately on emerging branching copiously into variously curved and delicate branchlets which occasionally anastomose near the base, are sometimes short and divaricate, sometimes long and serpentine; the ultimate branchlets often only 1 mm. thick; substance fleshy, white; teeth chiefly dependent from lower surface of branches, more or less uniformly distributed on the branches quite to the base; at the ends of the branches the teeth are usually on all sides and more or less erect occasionally drooping or pendent in terminal clusters, terete, acute, 0.5–5 mm. long; spores globose to suboval, smooth, uniguttulate, white, 4–5 $\mu$ wide; odor somewhat unpleasant; taste slightly pungent.

HAB.: On beech and hickory logs. Aug.–Dec.

RANGE: Canada, *Dearness;* New York, *Shear, Peck;* Vermont, *Banker, Lee;* Pennsylvania, *Schweinitz, Banker;* New Jersey, *Geismar;* South Carolina, *Ravenel;* Ohio, *Sanders;* Indiana, *Underwood, Banker, Arthur, Ellis & Wright;* California, *Eastwood.*

ICON.: Boccone, Mus. di Piante Rare, *pl. 303. f. 7.* 1697; Micheli, Nov. Plant. Gen. *pl. 64. f. 2.* 1729; Sowerby, Eng. Fung. *pl. 252;* Bulliard, Herb. de la France, *pl. 390;* Peck, Rept. N. Y. State Mus. 48: *pl. 24. f. 11–13;* Atkinson, Mushr. etc., ed. 1900, *f. 184* †; *Idem*, ed. 1901, *f. 195* †; McIlvaine, One Thous. Am. Fung. *pl. 134.*

EXSICC.: Ravenel, Fung. Cat. Exsicc. 24; Shear, N. Y. Fung. 45; Ellis and Everhart, N. A. Fung. 1708, 1908; Roumeguère, Fung. Gall. 3703; Sydow, Myc. March. 1016; Kellerman, Ohio Fung. 126.

* The first edition of this work was published in 1775; whether it contained the above species is not known to the writer but it seems probable that it did.

† The figures in the two editions are identical and typical figures of this species.

The plant seems to be most commonly a saprophyte on beech logs but I have recently found it growing on hickory. It has usually been referred by mycologists to *H. coralloides* Scop. Boccone, however, as early as 1697 figured the two forms as distinct. They are undoubtedly closely related, and intermediate forms are to be found difficult of assignment exclusively to either category, but this may also be said of *H. coralloides* and *H. caput-ursi*, or of *H. caput-ursi* and *H. Erinaceus*. In fact all the species of this group are so closely related and so highly variable in themselves as to lead to much confusion.

There appear to be at least two distinct forms of this species. In the one the branches divide freely into a multitude of fine terminal branchlets which are often upturned and more or less erect at the ends. The teeth become shorter toward the ends of the branchlets and frequently stand out in various directions like thorns, but the majority are somewhat pendent. McIlvaine's figure is an excellent one of this form and shows clearly the peculiar character of the tips of the branches. Atkinson's figures are evidently also of this type. The other form has the branches usually longer and more slender, branching less freely, frequently curved or serpentine, the ultimate branchlets curving downward, the teeth frequently longer toward the tip of the branch and always pendent. This is undoubtedly the plant figured by Bulliard as *H. ramosum*. I cannot, however, regard these two forms as distinct species as I have found them both growing from the same log and apparently from the same mycelium.

2. HERICIUM CORALLOIDES (Scop.) Pers. Com. Fung. Clav. 155. 1797

*Hydnum coralloides* Scopoli, Fl. Carn. **2**: 472. 1772.

*Hydnum crispum* Scopoli, Fl. Carn. **2**: 473. 1772.

*Medusina coralloides* Chevallier, Fl. Gen. des Env. de Paris **1**: 279. 1826, in part?

*Dryodon coralloides* Karsten, Rev. Myc. 3[1]: 19. 1881.

*Friesites coralloides* Karsten, Medd. Soc. Faun. et Fl. Fenn. **5**: 27. 1879.

Plant white throughout, branched from a single stipe-like base; branches stout, consisting of nearly sterile primary branches 2–6

cm. long, 1–1.5 cm. thick, and fertile secondary branches 0.5–1. cm. long, 2–5 mm. thick, often appearing as mere protuberances on the primary branches; substance fleshy, brittle to somewhat tough; teeth slender, terete, pendent chiefly from the secondary branches forming terminal drooping clusters, occasionally fasciculate on the primary branches, 3–10 mm. long; spores globose or subovoid, white, uniguttulate, 5.5–7 $\mu$ wide; taste mild but somewhat disagreeable.

HAB.: On beech and hickory logs. Aug.–Dec.

RANGE: Vermont, *Banker;* Massachusetts, *Farlow;* New York, *Cook, Banker;* Indiana, *Underwood, Banker.*

ICON.: Boccone, Mus. di Piante Rare, *pl. 304. f. 2.* 1697; Schaeffer, Fung. Bav. et Pal. Icon. *pl. 142;* Fries, Sverig. åtl. Svamp. *pl. 34;* Atkinson, Mushrooms, etc., ed. 1900, *pl. 67. f. 185; Idem.*, ed. 1901, *pl. 77. f. 196;* * Gibson, Edible Toadst. and Mushr. *pl. 28, 29.*†

EXSICC.: Desmazieres, Pl. Crypt. de France, 2160; Krieger, Fung. Sax., 1158; De Thümen, Fung. Aust., 622.

Specimens of this species are often referred to *H. caput-ursi*, which the plants greatly resemble. But in the latter species the ultimate branches spring from a massive tubercle, while in *H. coralloides* the whole plant is branched as in *H. laciniatum.* From the latter species *H coralloides* is distinguished by its larger spores and its relatively coarser branching, and especially in possessing two orders of branches, the primary without teeth except as borne in fascicles, generally on slight protuberances as if abortive branches, and the secondary, short usually straight branches bearing straight pendent teeth clustered chiefly toward the ends. The last feature frequently gives to the plant an appearance much like *H. caput-ursi* and doubtless has led to confusing the two species. The teeth are usually longer than in *H. laciniatum*, but this feature, as in all the species of this genus, is too variable to be of special value in specific diagnoses.

That the plants here described as *H. coralloides* Scop. are true

* These figures are given for *H. caput-ursi*, but in that species the branches are short and spring from a central tubercle, giving a more massive effect. In other respects the two species are very similar. The figure in the second edition is much superior to that in the first.

† The plates are marked *H. caput-Medusae*, but that species is not branched. *Cf. H. Erinaceus.*

representatives of Scopoli's original species and are not to be confounded with *H. caput-ursi* Fr. and that the plants here described as *H. laciniatum* Leers. are not *H. coralloides* Scop. will be evident from the following considerations: (1) Scopoli in his original description * said, "extremis ramulis teretibus, subulatis recte deorsum descendentibus." This conveys distinctly the idea that the pendent teeth are at the ends of the branches. (2) Again in a later work † he says, "Duas icones possideo, quarum una est stipes albus, horizontalis, fere semipedalis, digitum crassus divisus in ramos teretes, subadscendentes, ramossimos; *ultimis ramis modice deflexis et emittentibus aculeos concolores*, duas et tres lineas longos. Altera figura est cespes subovatus, pariter albus, crebris ramis instructus, quorum apices aculeis etiam semiuncialibus, perpendicularibus et fasciculatis terminati sunt." (Italics ours.) This likewise conveys the impression that the teeth are chiefly at the ends of the branches. The latter part of the account also contains a brief description of what became later *H. caput-ursi* Fries and it is evident that Scopoli associated the two forms as one species, differing chiefly in the character of the body and length of the teeth. In 1863 Fries separated the latter form as *H. caput-ursi* and remarked in his description that the periphery of the tubercle was broken up into little branches "ultimis *H. coralloidis* haud absimiles." Moreover, in his figures of the two plants he clearly represents in *H. coralloides* Scop. a plant whose ultimate branches and the arrangement of the teeth are essentially the same as his figure of *H. caput-ursi*.

The plants here discussed are among the most beautiful of the fungi. Their snowy masses of intricate branches standing up from some old log appear like the most delicate frost work. Their beauty naturally attracted the earliest mycologists and led to their being noted among the early records of fungi. The first authentic record we have is that of Steerbeck in 1675.‡ He cites Clusius 1601 but the plant figured by Clusius appears more probably some species of *Clavaria*.

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* Flor. Carn. 61. 1760.

† Flor. Carn. 2: 473. 1772. It was in this work that the name was published.

‡ Theatr. Fung. aft. het. Toon. der Camp. *pl. 27. f. G.* 1675.

### 3. **Hericium caput-ursi** (Fries)

*Hydnum caput-ursi* Fries, Monog. Hym. Suec. **2**: 278. 1863.

*Friesites caput-ursi* Karsten, Medd. Soc. Faun. et Fl. Fenn. **5**: 27. 1879.

*Hydnum caput-ursi brevispineum* Peck, Bull. N. Y. State Mus. Nat. Hist. **5**: 656. 1899.

Plant large, tuberculous, the tubercle narrowed behind into a comparatively small point of attachment about 1 cm. wide, subpyriform, compressed vertically or sometimes laterally, the outer portion of the tubercle broken up into numerous short stout deformed branches 0.5–2 cm. long by 0.5–3 cm. wide, which are again branched into smaller short branches that terminate in pendent teeth, the whole mass being 8–15 cm. long, 10–16 cm. wide, 6–12 cm. thick; * in a front view the mass appears more or less heart-shaped, color white to ochraceous, and in drying brownish to fuscous on the lower teeth; substance fleshy fibrous, somewhat tough; teeth slender terete, tapering, acute, subflexuose, pendent, shorter toward the top, 0.5–2 cm. long, about 1 mm. wide; spores globose to subovoid, numerous, white or hyaline, uniguttulate, 5.5–7 $\mu$ wide.

HAB.: On beech.

RANGE: Canada, *Macoun;* Vermont, *Burt;* New York, *Underwood, Cook, Peck, Southwick, Burlingham;* New Jersey, *Porter;* Indiana, *Underwood.*

ICON.: Fries, Icon. Select. Hym. *pl. 7;* Peck, Mem. N. Y. State Mus. Nat. Hist. **3**: *pl. 67. f. 8–12;* Peck, Rept. N. Y. State Mus. **51**: *pl. 56. f. 8–12.*

The plant seems to have been described by Scopoli in Flora Carniolica **2**: 473. 1772, but was referred to *H. coralloides.* Not until 1863 did it receive recognition as a distinct species. It is intermediate between *H. coralloides* and *H. Erinaceus,* being distinguished from the former by its tuberculous body and from the latter by the short branches from which the teeth are pendent. The tuberculous body is not always pendent as shown by Fries, but is sometimes horizontal and even ascending as shown by Peck. The plant varies also in the relative size of tubercle and branches and in the length of the teeth, apparently due to some local disturbances in the nutrition of the plant. Abnormally short teeth

* By length is meant in direction of growth; width is horizontal and at right angles to the first; and thickness is the vertical dimension.

are occasionally met with in other species of this genus but do not seem to warrant varietal distinction. The Macoun and Burlingham specimens are of this type.

4. HERICIUM ERINACEUS (Bull.) Pers. Com. Fung. Clav. 159. 1797

*Hydnum Erinaceus* Bulliard, Hist. de Champ. de la France, 304. *pl. 34.* 1791.

*Manina cordiformis* Scopoli, Pl. Subterran. *pl. 10.*

*Medusina patula* Chevallier, Fl. Gen. des Env. de Paris, 1: 279. 1826.

*Dryodon Erinaceus* Quélet, Ench. Fung. 192. 1886.

Plant body a more or less tuberculous mass narrowed behind to a comparatively small point of attachment, projecting usually horizontally from the substratum and terminating outwardly in long pendent teeth, in front view usually more or less heart-shaped, shining white throughout, becoming ochraceous to reddish-brown in drying; body of the tubercle subglobose to subpyriform, or compressed vertically, 5–10 cm. long, 3–12 cm. wide, 2–4 cm. thick, usually pendent, sometimes ascendant, solid, or more or less porous, or sometimes a mass of closely anastomosing branches, the upper surface more or less fibrillose; substance fleshy-fibrous, hygrophanous or dry; teeth long, slender, terete, tapering, acute, subflexuose to straight, dependent from the front of the tubercle, usually 2–3 cm. long by 1–2 mm. wide, at the top the teeth usually merge insensibly into the fibrils of the upper surface; spores globose to subovoid, uniguttulate, white, smooth, 4.5–5 by 5–6 $\mu$.

HAB.: On living oak, locust or beech, also occasionally on dead trees. May–Nov.

RANGE: New York, *Southwick, Clinton;* New Jersey, *Ellis, Murrill;* Pennsylvania, *Rau, Banker;* Delaware, *Commons;* Maryland, *Curtis;* Virginia, *Griffiths, Murrill;* Georgia, *Harper;* Florida, *Martin;* Alabama, *Skehan;* Ohio, *Lloyd, Ricksecker, Quiroga;* Indiana, *Brown, Underwood, Arthur;* Michigan, *Langdon;* Wisconsin, *Calkins;* Missouri, *Demetrio;* Kansas, *Cragin;* Louisiana, *Langlois;* Mexico, *Smith.*

ICON.: Boccone, Mus. di Piante Rare, *pl. 307.** 1697. Bulliard, *loc. cit.;* Krombholz, *pl. 51. f. 1–3;* Cordier, Les Champ.

* The two upper left-hand figures, not numbered.

*pl. 44. f. 2;* Gillet, *pl. 318*;* Roze et Richon, Atlas des Champ. *pl. 64. f. 1–5;* Vittadini, Desc. dei Fungh. Mang. *pl. 26. f. 1–3.*

EXICC.: Roumeguère, Fung. Select. 5602; Rabenhorst-Wint. Fung. Europ. 3641 †; Kellerman, Ohio Fung. 127.

If any species of this genus can be said to be more variable than any other that distinction belongs to *H. Erinaceus.* Yet it appears to be impossible to group the variations into species without making almost as many species as one finds specimens. The typical form of this plant is as described above. From this type form the plant varies extremely in almost every feature. The whole mass may be globose with a scarcely evident point of attachment or it may be strongly vertically compressed and broadened until the plant appears almost ungulate or dimidiate; it may be narrowed behind into a comparatively slender stipe, or it may be sessile; it may be horizontal, pendent, or with the upper portion of the tubercle ascendant; the tubercle may be lobed suggesting an approach to *H. caput-ursi,* or at the base of the teeth it may be irregularly perforate and obscurely branched, it may be perforate throughout, or finally may consist of a mass of anastomosing branches; the teeth may be long or short,‡ straight, curved, or flexuose, terete or flattened; the flesh may be soft, tough, or, at least when dried, flaky and brittle; the upper surface may be sparsely fibrillose, or it may be covered densely with long flexuose spore-bearing fibrils, or with short erect stiff processes, also spore-bearing. Forms characterized by the last named feature have usually been referred to *H. Caput-Medusae.* But the feature thus emphasized as a specific character appears to be only a more vigorous development of the normally sparse fibrils of the typical *H. Erinaceus,* even in the matter of bearing spores. Moreover, even these forms do not strictly correspond to the description and figure of *H. Caput-Medusae* Bull. The last named species does not appear to have been found in this country.

*H. Erinaceus* is found most commonly emerging from wounds in living oaks, often from holes made by woodpeckers; occasion-

* Numbered according to the "Liste" of the Author.

† The specimen, however, is from Perryville, Missouri.

‡ I have seen specimens in which the longest tooth was not over 5 mm. long and others in which the longest tooth was fully 30 mm. in length.

ally it is found on locusts or on beeches; sometimes it is found on dead logs. Of fifteen specimens whose habitat was given, ten were on injured living trees; of these seven were *Quercus*, two *Robinia*, and one *Fagus;* the remaining five plants grew on dead logs, one on *Quercus*, one on *Hicoria*, and the others unknown. There appeared to be no positive evidence that the character of the fungus was effected either by the species of the host, or by the condition of the substratum as to vitality. But this point can not be fully determined without more data and more careful observations as to the condition of the host. There would seem to be some significance in the fact that *H. Erinaceus* appears to prefer living oaks while *H. laciniatum* and *H. coralloides* equally prefer dead beech.

### 5. **Hericium croceum** (Schw.)

*Sistotrema croceum* Schweinitz, Syn. Fung. Car. Sup. 76. 1818.
*Hydnum croceum* Schweinitz, Syn. N. Am. Fung. 163. 1834.
*Hydnum Schiedermayeri* Heuf. Oesterr. Bot. Zeitschrift **20**: 33. 1870.

Plant body a resupinate subiculum, effused 7 cm.–1 m. long by 2–15 cm. wide, irregularly thickened into tuberculous protuberances 2–10 mm. thick, 0.5–2 cm. wide, from which the teeth depend, cream-colored to reddish buff towards the ends of the teeth, becoming darker in drying; subiculum pubescent to tomentose; margin determinate, fimbriate; teeth fasciculate, pendant from the tubercles, bulbous and pubescent at base, glabrous, subtranslucent toward the point, terete; the acute to flattened fimbriate apex, sometimes forked, 4–5 mm. long; spores white, ovoid, uniguttulate, 3.6 by 5.5 $\mu$; substance fibrous, somewhat tough.

HAB.: On living or dead apple tree. Aug.

RANGE: New York, *Banker;* New Jersey, *Griffiths;* Pennsylvania, *Rau.*

ICON.: Kalchbrenner, Icon. Select. Hym. Hung. *pl. 38. f. 4.*

EXSICC.: Ellis, N. Am. Fung. 930.

The Ellis plants in North American Fungi were referred to *H. Schiedermayeri.* A similar plant was found by the writer on the vertical side of a crevice in a living but diseased apple tree. This plant was almost a counterpart of Kalchbrenner's figure. In the same orchard was found another specimen effused for 20–25 cm. on the under side of dead apple-tree limbs. This plant was evi-

dently identical with the former in all essential features, but from its mode of growth the teeth were in general vertical to the substratum instead of appressed or parallel to it. It appears to present all the characters of *H. croceum* Schw. Schweinitz does not mention the habitat of his species further than that it was on dead wood. *H. Schiedermayeri* Heuf. has never been reported except on apple-tree wood, and Heufler expressly states that it is found only on apple trees. *H. croceum* Schw. appears to be the plant when growing on a horizontal substratum and *H. Schiedermayeri* Heuf. the same plant growing on a vertical substratum. Schweinitz adds that "it spreads on wood more rarely to a remarkable length and breadth." A specimen found by David Griffiths on an apple-tree log at Fort Lee, New Jersey, and now in the museum of the New York Botanical Garden, measures a meter long by 15 cm. wide. It is of remarkably vigorous growth, and the tomentose character of the subiculum has extended in some degree to the teeth.

The plant at first sight appears to have little in common with the preceding species of this genus. But the tuberculous thickenings of the subiculum from which the teeth chiefly depend, and the white ovoid smooth uniguttulate spores seem to indicate its proper association in the genus *Hericium*. The type specimen of Schweinitz is destroyed. *H. croceum* Schw. has also been reported from West Virginia, *Nuttall*, and Maine, *Harvey*, but I have not seen these specimens.

### 6. **Hericium fimbriatum** sp. nov.

Plant a resupinate subiculum, irregularly effused 5–7 cm. on a vertical substratum, fleshy, obscurely tuberculate, 1–15 mm. thick, whitish to reddish on the more exposed parts, in drying becomes dull ochraceous or isabelline with whitish margin; margin generally indeterminate but at the lower edge determinate, spreading, fan-shaped, fimbriate; subiculum consisting of more or less clearly distinguished branches anastomosing and forming thickened tubercles; on the upper part of the plant these branches end in free fimbriate points about 1 mm. long; teeth pendent on the lower part of the plant and from the underside of the tubercles, terete to flattened, with whitish fimbriate tips, 3–10 mm. long, 0.2–1.5 mm. wide; spores oblong, slightly curved, uniguttulate, 2–2.5 by 4–4.5 $\mu$, apparently white or hyaline.

HAB.: On a decaying stump of some hard wood, between the bark and wood. Oct.

RANGE: Pennsylvania, *Banker.*

The plant closely resembles specimens of *H. croceum* Schw. but differs in the whitish margin, the more flattened, and whitish fimbriate tips of many of the teeth, and particularly in the size and form of the spores.

### 7. **Hericium fasciculare** (Alb. & Schw.)

*Hydnum fasciculare* Albertini & Schweinitz, Consp. Fung. 269. *pl. 10. f. 9.* 1805.

Plant with little or no subiculum, whitish becoming reddish in drying; teeth fasciculate, pendent, often united at base and more or less confluent in groups of three or four; fascicles consisting of 4–12 teeth; teeth terete, slender, tapering, acute, 0.5–1.5 cm. long, center of tooth darker than surface.

HAB.: On decayed pine and fir trunks.

RANGE: Pennsylvania, *Schweinitz.*

Schweinitz in his description says "albidus pallens, sed ne tantillum quidem rufescens." But the specimen in the Philadelphia Academy of Sciences shows in its dried state a reddish color. The plant has also been reported from South Carolina, *Ravenel;* Alabama, *Peters;* North Carolina, *Curtis.* These I have not seen.

SPECIES INQUIRENDAE VEL EXCLUDENDAE

*Hydnum ramaria* Fr. has been reported from California *Harkness,* but I have seen no specimens.

*Hydnum ramosum* Schw. was described originally by Schweinitz in Syn. Fung. Car. Sup. 78. 1818. In his later work, Syn. N. Am. Fung. 162, he remarks, "Also observed at Bethlehem, but does not vary much from the former" (*i. e., H. coralloides*). No specimen has been preserved in the Schweinitz herbarium, the plant has never been reported by any one else, and finally the name itself is preoccupied by *H. ramosum* Bull. The species may, therefore, be wholly discarded.

## 3. STECCHERINUM S. F. Gray, Nat. Arr. Brit. Pl. **1**: 651. 1821

*Creolophus* Karsten, Medd. Soc. Faun. et Fl. Fenn. **5**: 28. 1879.
*Gloiodon* Karsten, *op. cit.* **5**: 28. 1879.

*Climacodon* Karsten, Rev. Myc. 3[1]: 20. 1881.
*Sclerodon* Karsten, Finlands Basidsv. 360. 1889.

Plants epixylous, sessile, or stipitate, more or less dimidiate effused reflexed, or rarely wholly resupinate; substance usually fibrous, tough, or sometimes subfleshy; teeth terete or flattened; spores smooth, ovoid to oblong, white or hyaline, minute.

Gray established the genus on *Hydnum Daviesii* Sow. = *H. ochraceum* Pers. But his work receiving little or no recognition, the genus was never taken up. In 1879 Karsten established the genera *Creolophus* on *H. corrugatum* Fr. and *Gloiodon* on *H. strigosum* Swartz. Later he established the monotypic genus *Sclerodon* on *H. strigosum* Swartz, making it thus a synonym of his own *Gloiodon* and actually quoting the latter as a synonym. There seems to be no reason whatever for this change of name. Karsten's efforts thus to segregate these plants into distinct genera appear to have been rather unsatisfactory and although the genus as here treated includes some rather widely varying forms it does not seem to be possible to separate them on any lines of natural cleavage, while the spore characters appear to indicate a high degree of uniformity.

**Synopsis of the Species**

Plants usually sessile or resupinate (substipitate in no. 2), spores more than 2 $\mu$ wide and 3 $\mu$ long.
  Substance of plant dry, fibrous, tough, when fresh; pileus less than 8 cm. wide.
    Plants densely gregarious, more or less confluent, whitish, grayish, or ochraceous.
      Pileus dimidiate, sessile, decurrent on the substratum or resupinate, scarcely pubescent. 1. *S. ochraceum.*
      Pileus more or less flabelliform, narrowed behind, substipitate, rarely resupinate, usually strigose hairy. 2. *S. Rhois.*
    Plants not confluent.
      Surface of pileus pubescent or smooth.
        Pileus mostly drab, 3 cm. or more wide. 3. *S. Morgani.*
        Pileus isabelline to umber, usually less than 3 cm. wide. 4. *S. reniforme.*
      Surface of pileus densely strigose. 5. *S. strigosum.*
  Substance of plant juicy or at least moist when fresh.
    Surface of pileus smooth or scabrous; plant small, less than 6 cm. wide. 7. *S. agaricoides.*
    Surface of pileus pubescent or tomentose; plants usually large, more than 10 cm. wide.
      Substance of plant gummy, subflexible when dry. 6. *S. pulcherrimum.*

Substance of plant not gummy, compact, somewhat dry, more or less brittle when dry. 8. *S. septentrionale.*

Plants more or less stipitate (sometimes sessile or resupinate in no. 10); substance dry, fibrous.

Pileus branched, flabellate; teeth radially compressed, less than 1 mm. long; spores more than 3.5 $\mu$ wide. 11. *S. plumarium.*

Pileus scarcely flabellate; teeth subterete; spores less than 3 $\mu$ wide.

Plant large, complicated; teeth straight, becoming dark, white to light or dark umber, sometimes bluish. 9. *S. adustum.*

Plant small, simple; teeth flexuose, white to ochraceous, not turning dark. 10. *S. adustulum.*

1. STECCHERINUM OCHRACEUM (Pers.) S. F. Gray, Nat. Arr. Brit. Pl. 1: 651. 1821

*Hydnum ochraceum* Persoon; Gmelin, L. Syst. Nat. 2: 1440. 1791.

*Hydnum Daviesii* Sowerby, Eng. Fung. 15. 1797.

*Hydnum plumarium* B. & C., Grevillea 1: 97. 1873. Not B. & C. Jour. Linn. Soc. 10: 324. 1869.

*Climacodon ochraceus* Karsten, Ryssl. Finl. och den Skand. Half. Hattsv. 2: 98. 1882.

*Leptodon ochraceum* Quélet, Ench. Fung. 192. 1886.

*Hydnum conchiforme* Saccardo, Syll. Fung. 6: 458. 1888.

Plant sessile, pileate, effuso-reflexed or rarely wholly resupinate; pilei more or less imbricate, often confluent, sessile, subdimidiate, depending, decurrent behind along the substratum, often spreading effused, usually appearing more or less campanulate, 0.2–4 cm. wide, 0.2–1.5 cm. long; surface sulcate-zonate, subrugose, subtomentose, ochraceous to cinereous or gray; margin incurved or reflexed, entire, pubescent, sterile for 1 mm. or more; substance tough, fibrous, thin, 1 mm. or less thick, whitish, dry; hymenium ochraceous, whitish-pubescent; teeth slender, short, compressed to subterete, often forked, acute, tough, shorter toward margin, 1.5 mm. or less long, 0.25 mm. wide, crowded 3 and 4 to one millimeter; spores minute, ovoid, smooth, granular, hyaline, 3 by 3.5 $\mu$; tasteless, odorless.

HAB.: On dead *Carpinus*, *Thuja*, *Viburnum*, *Fagus*, *Acer*. Throughout the year.

RANGE: Canada, *Dearness*, *Macoun*; New York, *Shear*; New Jersey, *Ellis*; Pennsylvania, *Banker*, *Jackson*; Alabama, *Earle*; Ohio, *Morgan*; Iowa, *Holway*; Texas, *Billings*.

ICON.: Persoon, Syn. Meth. Fung. *pl. 5. f. 5*; Sowerby, Eng. Fung. *pl. 15*.

EXSICC.: Shear, New York Fung. 114.

The collections indicate that the species varies greatly in form and habit. It also undergoes considerable change in appearance during growth. *Hydnum conchiforme* appears to me to be a young state of the plant.

### 2. **Steccherinum Rhois** (Schw.)

*Hydnum Rhois* Schweinitz, Syn. Fung. Car. Sup. 77. 1818.
*Hydnum flabelliforme* Berkeley, Lond. Jour. Bot. 4: 306. 1845.

Plant pileate, short stipitate, subsessile, or effused to resupinate, subimbricate, laterally confluent; pileus flabelliform to subdimidiate, horizontal or ascending, narrowing behind, 1.5–2.5 cm. wide, 1–3 cm. long, surface sulcate-zonate, often radiately rugose, strigose-hairy to subtomentose, the strigose character more marked toward the margin, light gray on older and more exposed pilei, light buff on younger and more protected parts; margin entire, repand, subfertile or sterile less than 0.5 mm. incurved or reflexed, puberulent; substance fibrous, tough, dry, thin; stem lateral, short, vertically compressed, less than 5 mm. long or wanting and plant spreading back resupinately over the substratum; hymenium ochraceous, whitish-pubescent, often delimited behind; teeth crowded short, more or less decurrent, ochraceous to buff, compressed, often forked, whitish-puberulent, 1–2 mm. long, 3 and 4 to one millimeter; spores elliptical or oblong, smooth, granular, hyaline, 2–2.5 by 3–3.5 $\mu$; tasteless, odorless.

HAB.: On dead *Liquidambar*, *Nyssa*, *Rhus*, *Mohrodendron*, *Quercus*. Throughout the year.

RANGE: Pennsylvania, *Banker;* Maryland, *Ricker;* New Jersey, *Ellis;* South Carolina, *Ravenel;* Alabama, *Earle;* Florida, *Rolfs;* Ohio, *Morgan;* Indiana, *Underwood;* Texas, *Billings, Hodson.*

EXSICC.: Ravenel, Fung. Am. Exsicc. 455 (as *Hydnum ochraceum*); Ellis, N. Am. Fung. 605, as (*Hydnum ochraceum*); Ravenel, Fung. Car. Exsicc. 25.

The type specimen in the Schweinitz herbarium is entirely destroyed. I have not found it possible to separate *H. flabelliforme* from the above species. Berkeley himself expressed doubt as to their being distinct. This species like *S. ochraceum* is extremely variable but with abundance of material one finds that these various forms blend inextricably with each other. There is some reason to

doubt whether *S. ochraceum* and the present species can be maintained as specifically distinct. Young and resupinate forms of the two species are practically indistinguishable, and the fragments commonly sent in by collectors for identification will frequently puzzle the expert to decide to which species they should be referred; while many forms are found so unlike either as to render it impossible to assign them to one rather than the other. The latter might be regarded as distinct species if there were any evidence that their distinguishing characters were constant. Nevertheless, in mature well developed plants, the contrast in the character of the pilei is very marked and seems to warrant the recognition of at least two distinct but closely related species.

### 3. **Steccherinum Morgani** sp. nov.

Plant pileate, sessile, gregarious, subimbricate, distinct; pileus dimidiate to subflabelliform, horizontal, thin, about two millimeters thinning out to the margin, thickened at point of attachment to 5 mm., 3.5–6 cm. wide, 3.5–4 cm. long; surface subradiately tomentose or pubescent, uneven toward center, sulcate-zonate toward margin, drab to pale buff; margin smooth, uneven, straight, thin, acute, substerile; substance fibrous, tough, subflexible when dry, light buff; teeth short, straight, compressed, forked or fimbriate, umber to tawny in side view but the hymenium between the teeth is light buff, 1 mm. long shortening to the margin, 0.17–0.20 mm. wide, 3 and 4 to one millimeter.

Ohio, *Morgan*.

The above description is drawn up from dry material from Mr. A. P. Morgan. Morgan referred the plant to *Hydnum glabrescens* B. & R. but comparison with the type of that species convinces me that they are not the same.

### 4. **Steccherinum reniforme** (B. & C.)

*Hydnum reniforme* B. & C. Jour. Linn. Soc. 10: 325. 1869.
*Hydnum glabrescens* Berk. & Rav. Grevillea 1: 97. 1873.

Plants pileate, subsessile, gregarious but not confluent; pileus reniform to orbicular, sometimes subcuneiform, horizontal, subpendent, 3 mm. to 3 cm. wide, 2 cm. long, less than 1 mm. thick; surface even, sulcate zonate, subpubescent, color chiefly light umber or isabelline, sometimes alternating toward the margin with cream-colored zones; margin cream-colored, thin, even, entire

obtuse, sterile; substance tough, subflexible; stem scarcely evident, 4–8 mm. wide, lateral or superior; hymenium often zonate, concolorous with surface; teeth short, terete or compressed, often forking, umber, the longest subtranslucent, opaque toward margin, minutely pubescent, 1 mm. long near the base of pileus shortening to the sterile margin, 3 and 4 to one millimeter; spores not observed.

Honduras, *Wilson.*

The type specimens were from Cuba. The plant has also been reported from Alabama, *Atkinson.* I have not seen the latter. The Honduras specimens differ from the type in a firmer substance to the pileus, and more distinct color zonation. In the type the teeth are distinctly pubescent. The above description was made from dried, pressed material.

*Hydnum glabrescens* Berk. & Rav., was described from material from South Carolina, *Ravenel* no. 1634, and Ceylon, *Thwaites* no. 385. The latter specimen is now a poor scrap which appears to have been from a resupinate plant. Such characters as can be made out do not seem to indicate the same thing as the Ravenel specimen, as might be expected from its distribution. Ravenel no. 1634 does not appear to be essentially distinct from the type of *Hydnum reniforme.* It is a slightly larger plant, but has the same color, substance, and sulcate-zonate features. In form it is irregularly dimidiate, and the teeth do not appear to be pubescent but they are in such poor condition that this character is not certain. No spores were found on either plant. At Kew a variety of things is placed with this species. The glabrate character which gives the specific name to the species is not so marked in the type specimen as it is in the type specimen of *Hydnum reniforme.* On the whole it appears doubtful from a comparison both of the descriptions and of the type specimens whether *Hydnum reniforme* B. & C. and *H. glabrescens* B. & R. are really distinct species.

### 5. Steccherinum strigosum (Swartz)

*Hydnum parasiticum* Persoon, Icon. et Descrip. Fung. 55. 1800. Not *H. parasiticum* L.

*Hydnum strigosum* Swartz, Kongl. Vetensk. Acad. Nya Handl. 1810: 250.

*Gloiodon strigosus* Karsten, Medd. Soc. Faun. et Fl. Fenn. 5: 28. 1879.

*Sclerodon strigosus* Karsten, Finl. Basidsv. 361. 1889.

Plant pileate, sessile, solitary or imbricate; pileus dimidiate, subconvex, or when imbricated deformed; surface scabrous with strigose branched hairs, fuscous, becoming blackish; margin lobed; substance dry, fibrous, fuscous; teeth terete, long, flexuose, forked near the margin, at first whitish variegated, becoming glaucous-cinereous.

RANGE: Pennsylvania, *Schweinitz.*

ICON.: Persoon, *op. cit. pl. 14. f. 1.*

The species appears to be rare. It has been reported from New York, *Peck*, and from Massachusetts, *Frost.* I have seen only the Schweinitz specimen. This is peculiar and unlike any thing else I have seen. The plant throughout is very dark brown to blackish, the pileus excavated within into sponge-like cavities, the surface covered with a dense coating of slender dark hairs; teeth long, flattened and confluent so as to form tubes, the hymenial surface appears much like *Fistulina.* The specimen is only a fragment and old. The description given above is adapted largely from Swartz. Persoon received a specimen of the plant from Swartz which he figured and described as *Hydnum parasiticum* L. But afterward Swartz pointed out that it was not the species of Linnaeus. Persoon, however, retained the name, having transferred *Hydnum parasiticum* L. to another genus. Finally Swartz published the plant as *Hydnum strigosum.*

6. **Steccherinum pulcherrimum** (Berk. & Curt.)

*Hydnum pulcherrimum* B. & C. Hooker's Jour. Bot. and Kew Gard. Misc. 1: 235. 1849.

Plant pileate, sometimes effused subresupinate, sessile, more or less imbricate, confluent at base, the mass 10–20 cm. wide, 5–10 cm. long, 5–7 cm. thick; pileus horizontal, subconvex, dimidiate to subflabelliform; surface uneven, azonate, densely strigose or tomentose, the hairs up to 2 mm. in length, white at first becoming ochraceous to tawny or reddish-tawny; margin thin, entire, subrepand, substerile; substance soft, juicy, fibrous when fresh, fibrous-tough, flexible, somewhat soft and gummy when dry; teeth slender, terete, glabrous, ochraceous to reddish, translucent, gummy when dry, 1–5 mm. long, 3 and 4 to one millimeter; spores oblong, smooth granular, hyaline, 2–2.5 by 4.5–5 $\mu$, very transparent with one or more dark granules.

HAB.: On decaying logs of *Hicoria, Quercus,* and *Liquidambar.* Throughout the year.

RANGE: Massachusetts, *Blake;* New York, *Underwood, Cook;* New Jersey, *Underwood;* Pennsylvania, *Sumstine;* Dist. of Columbia, *Cook;* Delaware, *Commons;* South Carolina, Georgia, *Ravenel;* Florida, *Calkins, Rolfs;* Alabama, *Underwood;* Louisiana, *Langlois, Lloyd;* Ohio, *Morgan.*

EXSICC.: Ellis & Everhart, N. Am. Fung. 2d. Ser. 2308.

The species appears to be chiefly southern in its distribution, being particularly abundant in the Gulf States. The northern collections are relatively few and many of the plants differ from the typical specimens when dried in being less gummy and flexible, with apparently longer teeth, and a less tomentose surface. Possibly a more careful comparison of the living plants may enable us to separate a distinct northern species, but plants from Pennsylvania are evidently identical with the more southern form.

### 7. **Steccherinum agaricoides** (Swartz)

*Hydnum agaricoides* Swartz, Prodr. 149. 1788.
*Hydnum discolor* Fries, Sys. Myc. 1: 411. 1821.

Plant pileate, sessile, solitary; pileus semiorbicular, narrowed to a point of attachment, convex, 4 cm. across; surface smooth, scabrous toward the margin, where it is obscurely zonate, whitish, becoming dark ferruginous; substance fleshy, brittle when fresh, becoming tough, whitish; teeth slender, cylindrical, obtuse or acute, crowded, translucent, ferruginous brown, 4–6 mm. long.

HAB.: On dead logs.

RANGE: Jamaica, *Swartz.*

ICON.: Berkeley, Ann. and Mag. Nat. Hist. 10: 380. *pl. 10. f. 9.*

I have not seen a specimen of this species and the above description is adapted from Swartz's description of *Hydnum agaricoides* and Berkeley's redescription and figure, *loc. cit.*

The plant appears to be a distinct species and is evidently closely related to *S. pulcherrimum.* Fries' description of *Hydnum discolor* is taken almost wholly from Swartz, Fl. Ind. Occ. 3: 1927, but why he changed the name is not apparent.

### 8. **Steccherinum septentrionale** (Fries)

*Hydnum septentrionale* Fries, Sys. Myc. 1: 414. 1821.
*Climacodon septentrionalis* Karsten, Rev. Myc. 3[1]: 20. 1881.

Plant pileate, sessile, consisting of many pilei, crowded, imbricate, confluent at the base, the whole mass arising from a single relatively small point of attachment 2 cm. wide and spreading out into a hemispherical mass 30 cm. in diameter; the pilei arranged in uniform horizontal layers smaller at the top and bottom and larger in the center, convexed to depressed, subdimidiate, 4–30 cm. wide, 2–20 cm. long, 1–3 cm. thick; surface uneven, subrugose, floccose pubescent, azonate, white; margin incurved, repand, obtuse, subfertile; substance tough, fibrous, moist, obscurely zonate, white; teeth terete to subangular, flexible, tough, somewhat brittle when dry, long, crowded, milk-white, becoming buff to reddish when dried, 15–17 mm. long, 0.5–1 mm. wide, 1 and 2 to one millimeter; spores smooth, oblong, obliquely apiculate, hyaline, finely granular, 3–3.5 by 5–7 $\mu$.

HAB.: On trunks of dead or dying *Fagus* emerging from knots, also on *Nyssa*, *Acer*, *Ulmus*.

RANGE: Canada, *Dearness;* Massachusetts, *Blake;* New York, *Underwood;* New Jersey, *Ellis;* Pennsylvania, *Haines*, *Evcrhart*, and *Jefferis;* Ohio, *Lloyd*, *Kellerman;* Indiana, *Underwood*, *Banker*, *Cole*.

ICON.: Fries, Icon. *pl. 9, 10.*

EXSICC.: Ellis, N. Am. Fung. 318; Ellis and Everhart, Fung. Columb. 304.

The species resembles *S. pulcherrimum* Berk. somewhat but is larger coarser and of tougher and dryer substance. It is chiefly northern in its distribution and may represent a northern type of the former species. The above description was made from a fresh plant of typical form. The semiglobose form of the mass made up of horizontal pilei standing out at right angles to a vertical orbicular disk is a very characteristic form of the plant and is well shown in Fries' figure, *loc. cit.* The disk is separable from the substratum, being permanently connected only by the small point at which the fungus emerges from the tree. As the mass becomes very large and heavy, sometimes weighing 27 pounds, it often breaks off from the trunk and falls. Some plants appear to grow more diffuse and lose the regular orbicular character. Such a one is shown in Atkinson's College Botany, 553. It seems possible that this may represent a different species or at least a variety but I have not seen a living plant of this type. Because of the immense size of this plant ordinary herbarium specimens are mere

fragments and give little idea of many important characters of the species. Even these show considerable differences but without knowing the habit and general character of the plant from which they were obtained, it would be impossible properly to discriminate species.

### 9. **Steccherinum adustum** (Schw.)

*Hydnum adustum* Schweinitz, Syn. Fung. Car. Sup. 77. 1818.

Plant pileate, stipitate to subsessile, more or less complicated; pilei usually several, medium size, the mass 4–8 cm. wide, subdimidiate, reniform or sometimes flabelliform, lateral, rarely spreading around behind the stipe and becoming by confluence subregular, subplane, convex, depressed toward the stipe, roughened above with more or less abortive pileoli, 2–6 cm. wide; surface subeven, finely pubescent, whitish to buff and reddish-umber toward the margin, more or less obscurely zonate; margin thin, acute, fertile to substerile; substance fibrous, dry, whitish to pale buff, brittle when dry, 2 mm. or less thick; stem short stout, subcylindrical to irregular or compressed, more or less enlarged below, velvety pubescent, solid, hard, whitish within, branching above often into a series of lateral pilei; teeth slender, tapering, crowded, straight, angular to subterete, acute, often forking and fimbriate, sometimes flattened and confluent forming concentric bands of pores, subdecurrent, white, becoming ochraceous to umber or fuscus, sometimes bluish, 1–3 mm. long, 0.1–0.2 mm. wide, 4 and 5 to one millimeter; spores oblong, smooth, hyaline, granular, obliquely apiculate, minute, 1–1.5 by 3 $\mu$.

HAB.: On dead decaying, half buried branches. Aug.–Nov.

RANGE: Connecticut, *Underwood & Earle, White;* New York, *Earle;* New Jersey, *Ellis;* Pennsylvania, *Sumstine, Jackson;* Virginia, *Maxon, Murrill;* North Carolina, *Memminger;* Alabama, *Earle;* Ohio, *Lloyd, Morgan;* Kentucky, *Lloyd;* Iowa, *Holway;* Missouri, *Demetrio, Glatfelter.*

ICON.: Schweinitz, *op. cit. pl. 2. f. 7–9.*

EXSICC.: Rabenhorst-Winter, Fung. Eur. 3324; Ellis, N. Am. Fungi. 317.

The species presents a considerable amount of variation in form and coloring. The plant is usually white throughout at first becoming darker on the teeth and margin with age or in drying. The darkening of the margin and teeth in some cases becomes only a deep buff and in other cases becomes a dark lavender or blue which sometimes spreads more or less over the pileus.

In some instances also the formation of pores by the coalescence of the teeth is carried so far that one might be deceived into supposing that the plant belonged to the Polyporaceae.

### 10. **Steccherinum adustulum** sp. nov.

Plant pileate, stipitate or sessile, rarely resupinate, often deformed; pileus dimidiate, reniform, flabelliform, or irregular depressed, sometimes infundibuliform; surface radiately fibrous, obscurely zonate, minutely pubescent, white with pale brownish zones, becoming cream-colored when dry, 0.5–4 cm. wide; margin thin, acute, crimpled when dry, subfimbriate, substerile; substance tough, fibrous, white, brittle when dry, very thin, less than 1 mm. thick; stem usually slender, commonly more or less deformed, excentric, lateral or wanting, solid, velvety pubescent, enlarged at the base; teeth slender, crowded, flexuose, subterete or flattened, often forked, puberulent, less than 2 mm. long, 5 and 7 to one millimeter, white becoming cream-colored to pale ochraceous, not turning dark; spores ovoid, smooth, granular, hyaline, 1.5 by 2.5 $\mu$.

HAB.: On rotten sticks on ground in woods. July.

RANGE: New York, *Lobenstine, Banker;* New Jersey, *Ellis.*

The species shows considerable degree of variation from mesopodous through pleuropodous to apodous and even resupinate forms. The most common form is that of a horizontal dimidiate or reniform pileus with lateral, vertical or inclined stipe. In some cases the base of the stipe spreads out over the substratum, and producing teeth forms a resupinate portion of the plant. More commonly, however, the resupinate forms simply have the margin reflexed or without flexure projecting from the substratum as a pileus. When wholly resupinate the plant is scarcely distinguishable from some forms of *S. ochraceum*, but I have always found these associated with the pileate plants in such a way that there was no question as to the identity of the species. The pileate forms show very close relationship to *S. adustum* and the plant has usually been referred to that species, but it differs in its smaller size, more delicate structure, slender flexuose almost capillary teeth, its permanent light color throughout showing no trace of an "adustus" margin or teeth, and finally its ovoid and shorter spores. I have found this plant common in mixed woods about Schaghticoke, N. Y., but have never found *S. adustum* in that region. The spores of

the dried plant when mounted in water appear shriveled and may be thought to be curved and with peculiar dark bands. This appearance may be of some value in separating species, but it entirely disappears if the spores are mounted in weak potassic hydrate and they appear then distinctly ovoid and highly transparent.

### 11. **Steccherinum plumarium** (B. & C.)

*Hydnum plumarium* B. and C. Jour. Linn. Soc. **10**: 324. 1869, not *H. plumarium* B. and C. Grevillea **1**: 97. 1873.

Plant stipitate, pileate, about 5 cm. long; pileus apparently flabelliform, branched; branches flattened vertically and broadening outwardly, 0.5–3 cm. long, 1–20 mm. wide, in color white or pale alutaceous to reddish, subzonate, darker toward the margin and underneath; surface smooth, to subrugose, margin thin, deeply laciniate, apparently sterile; stem, 1.3 cm. long by 1.5 mm. thick; substance membranaceous, subtranslucent, showing zonations distinctly by transmitted light, fibrous, thin, less than 0.5 mm. thick; teeth minute, irregularly distributed, occasionally on both sides of pileus, blunt, conical, or flattened, often united at the base into longitudinal ridges, from which the tips of the teeth project like crests, the ridges sometimes appearing to anastomose forming pores and giving rise to the feature described by Berkeley as a porous hymenium; teeth similar in substance to the pileus, 0.2–0.8 mm. long, 0.07–0.09 by 0.09–0.27 mm. wide; spores hyaline, smooth, subglobose-ovoid, guttulate, 3.6 × 5 $\mu$ wide.

HAB.: On stumps in woods. June–July.

RANGE: Cuba, *Wright;* Jamaica, *Maxon 2949.*

Berkeley's original description is unsatisfactorily brief and the above description drawn up from dried material may perhaps be supplemental. The species, however, should be easily recognized as it is wholly unlike anything else in the Hydnaceae. Its deeply laciniate, palmately branched pileus and membranaceous substance clearly distinguish it from all other pileate species. Its minute teeth, however, may cause it to be overlooked as a member of this family.

SPECIES DUBIAE ET INQUIRENDAE

*Hydnum decurrens* Berk. & Curt., Jour. Linn. Soc. **10**: 325. 1869. The species was described from material from Cuba. The type specimens show a plant closely resembling forms of *S. Rhois* differing chiefly in the teeth which appear to be more

slender and to have a lilac tint rather than ochraceous. It is probable that it is a good species, but as no specimens except the type are known and a satisfactory description is not possible at present, it seems best not to include the species in the present genus until it can be further studied. If specimens are found they will probably be traced through the key to *S. ochraceum* or *S. Rhois* from either of which they will probably be distinguished by the lilac colored teeth.

*Hydnum friabile* Fries, Nov. Symb. Myc. 106. 1855. The species was described from material received from Curtis. From the description it appears very close to *H. pulcherrimum* B. & C., and it would be regarded as a synonym of that species but for the fact that Fries himself notes this fact and says "*H. pulcherrimum* Berk. et Curt. aculeis multisque notis conspicue differt." In view of this definite statement it is best not to reduce the species to synonymy until the type specimen can be examined.

*Hydnum molle* Schwein. Syn. N. Am. Fung. 162. 1834. Not *H. molle* Fries. The description is brief and suggests the possibility of the species belonging to the genus *Irpex* of the family Polyporaceae.

Several European species related to the present genus have been credited to this country, but as I have not seen the specimens they have not been included in the synopsis. These are as follows: *H. occarium* probably intended for *H. occarinum* Batsch reported by Schweinitz from Pennsylvania. No specimen was found in the Schweinitz Herbarium. *H. cirratum* Pers. often written incorrectly *cirrhatum*, reported from Alabama, *Beaumont;* Ohio, *Lea;* North Carolina, *Curtis;* New York, *Peck;* Kentucky, *Morgan.* It seems probable that the plants thus reported are *H. pulcherrimum* or *H. septentrionale. H. geogenium* Fr. reported from New York, *Peck.* The plant may be of this species but the determination is not wholly satisfactory.

4. ECHINODONTIUM Ellis & Ev. Bull. Torrey Club **27**: 49. 1900

*Hydnofomes* Hennings, Hedwigia **28**: 267. 1901.

Plant apodous, hard, woody, perennial; teeth woody; hymenium beset with setae; spores smooth, guttulate, hyaline.

1. ECHINODONTIUM TINCTORIUM Ellis & Ev. Bull. Torrey Club **27**: 49. 1900

*Fomes tinctorius* Ellis & Everhart, Bull. Torrey Club **22**: 362. 1895.

*Hydnum tinctorium* Lloyd, in Ellis & Everhart, Bull. Torrey Club **27**: 49. 1900.

*Hydnofomes tsugicola* Hennings & Shirai, Hedwigia **28**: 267. 1901.

Plant pileate, dimidiate, sessile, subungulate, perennial, 13 cm. wide, 7 cm. long, 1–5 cm. thick; surface sulcate-zonate, tomentose, rimose, dirty brown to fuliginous at margin; margin thick, rounded, even; substance fibrous woody, ferruginous to bright red, growing downward about the teeth so that they become more or less imbedded; teeth stout, compressed to flattened, blunt or dentate, drab, covered with a whitish pubescence and with scattered reddish conical setae 15–20 $\mu$ long, woody, center red, similar in substance with the pileus, 1–2 cm. long by 1–3 mm. wide; spores hyaline, broadly elliptical, smooth, 4.5–5 by 6–7 $\mu$.

HAB.: Parasitic on *Abies* and *Tsugà*. July.

RANGE: Alaska, *Swan;* Washington, Idaho, *Piper.*

The type specimen from Alaska is in the New York Botanical Garden. It has the teeth all broken off and thus looks as though the hymenial surface was composed of pores. This, together with its woody character, so entirely unlike anything previously known in the Hydnaceae misled Ellis and caused him to describe it as a *Fomes.* Later a more perfect specimen coming to hand he established the genus *Echinodontium* for this species.

In 1901 Hennings established the genus *Hydnofomes* on *H. tsugicola* Henn. & Shir. a plant found on *Tsuga diversifolia* Shir. in Japan. The species, however does not seem to differ essentially from the American plant. Hennings gives spore measurements somewhat larger, 5–7 by 4–5 $\mu$ and says, "pileis imbricatis decurrente effusis."

The species is unique among the Hydnaceae and shows a close relationship to the woody Polyporaceae.

5. SARCODON Quélet; Karsten, Rev. Myc. $3^1$: 20. 1881

Plants usually terrestrial, mesopodous, fleshy, more or less brittle, generally dark colored, brown to fuscous or black, rarely light brown or gray; teeth terete rarely compressed; spores small 4–7 $\mu$

wide, subglobose to ovoid, coarsely tuberculate, often appearing irregular, dark colored usually brown to fuscous, occasionally pale.

The first genus ever organized out of the group of plants now known as the Hydnaceae was established by Dillenius, *Catalogus Plantarum circa Gissam nascentium* 188, *pl. 1.* 1719, and was called *Erinaceus.* The plant described and figured in the above cited reference was undoubtedly the one now known as *Hydnum repandum* L. In 1735* Linnaeus, *Systema Naturae*, proposed the name *Hydna* as a substitute for *Erinaceus* Dill. Later the name was changed to *Hydnum* and finally it appeared in the *Species Plantarum* 1753 with four species listed under it, namely, *H. imbricatum*, *H. repandum*, *H. tomentosum* and *H. auriscalpium.* According to the principles here followed, although *H. imbricatum* (the type of *Sarcodon*) was the first species mentioned, *H. repandum*, the original *Erinaceus* of Dillenius, becomes the type of the genus *Hydnum.*

The genus, as thus originally established by Dillenius and reëstablished by Linnaeus, was so natural and clearly marked by its awl-shaped teeth that it has never been called in question, and the only confusion that has ever arisen concerning it has been from a failure to follow an obviously fundamental principle of nomenclature. Even if one does not accept the modern doctrine of generic types, it must be admitted that at least some one or more of the species given under a genus by its author at the time of its publication must be regarded as such type, otherwise there is no ground for generic stability and the very expression "generic type" is meaningless. It is to be observed that the genus *Hydnum* as established in 1753 by Linnaeus consisted wholly of stipitate plants, and it is absurd to restrict the name to resupinate forms.

The toothed hymenium was so obvious and distinctive a character of these plants that it became customary to refer everything possessing this feature to *Hydnum* until the genus became loaded

*In my "Historical Review of the Genera of the Hydnaceae," Bull. Torrey Club 29 : 438, it was stated that the name Hydna was proposed in 1737. I had not then seen a copy of the rare first edition of the Systema Naturae. I have to thank Dr. Barnhart for calling my attention to Fee's reprint. From this it appears that the facts are as stated in the text.

down with an incongruous mass of forms having only one common characteristic, that is a toothed hymenium. Several attempts have been made to evolve from this chaos something like a generic homogeneity. These efforts have not been without success but have unfortunately been in most cases largely vitiated by a failure to regard any definite principles of nomenclature.

In 1878 Quélet, in the *Clavis Hymenomycetum* proposed to restrict the name *Hydnum* to the resupinate forms of the genus and then suggested the name *Sarcodon* for the fleshy mesodopous forms. His treatment of *Hydnum* as a genus of resupinate species has no justification in any rational system of nomenclature, since not one of these forms was recognized under the original Linnaean genus or even its prototype, the *Erinaceus* of Dillenius. Moreover, Quélet failed to establish his genera in accordance with any rational principles* and his work might be wholly ignored but for the fact that his absurd perversion of nomenclatorial principles was taken up by so careful and discriminating a botanist as Karsten who, strangely repudiating his own far more logical work,† gave to Quélet's labors a recognition that their intrinsic merit did not deserve. In this Karsten has been followed by Patouillard, Schroeter and Hennings, much of whose work is, therefore, built nomenclatorially upon a foundation of sand.

The genus as here treated is closely related to *Hydnum* L. on the one side, and to *Hydnellum* Karst. on the other, differing from the former in the generally dark color of the plants and especially in the character of the spores; from the latter it differs chiefly in the brittle fleshy substance.

**Synopsis of the Species**

Spores pale; teeth connected at base by anastomosing ridges. 1. *S. reticulatus.*

Spores colored; teeth not connected by ridges.

Pileus densely tomentose or strigose. 3. *S. cristatus.*

Pileus smooth, subpubescent, or scaly.

Pileus glabrous, grayish.

Plant large, 8–12 cm. wide; stem scabrous. 2. *S. scabripes.*

Plant medium, 2–6 cm. wide; stem smooth. 4. *S. Blackfordae.*

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* See p. 102.

† Symb. ad Myc. Fenn. in Medd. Soc. Faun. et Fl. Fenn 5: 26. 187.

Pileus thin, blackish or dark olivaceous, small, less than 3 cm. wide. 10. *S. atro-viridis.*

Pileus fuscous or some shade of brown or red.*

Pileus thick; stem stout, usually shorter than the width of the pileus; teeth coarse usually more than 5 mm. long.

Surface of the pileus smooth or subpubescent. 6. *S. laevigatus.*

Surface of pileus more or less scaly. 7. *S. imbricatus.*

Pileus thin; stem slender, length equal or greater than width of pileus, teeth fine, less than 5 mm. long.

Surface of pileus smooth or subpubescent; stem radicating; plant small. 5. *S. fuligineo-violaceus.*

Surface of pileus more or less scaly.

Plant small; scales fine; flesh drying thin, hard, dark, subtranslucent. 9. *S. Underwoodii.*

Plant large; scales coarse; flesh drying opaque, fibrous, somewhat soft or pithy, tan colored. 8. *S. fennicus.*

### 1. **Sarcodon reticulatus** sp. nov.

Plant low, broad, alutaceous to terra-cotta; pileus plane or slightly depressed, somewhat irregular and slightly uneven, 7–15 cm. wide, more or less confluent; margin thin, incurved, subrepand, sterile; surface at first tomentose or pubescent, at length smooth or subsquamulose in the center of the disk, alutaceous to reddish at center fading out to pale buff or white at margin; substance fleshy, somewhat fragile, but of fibrous structure, whitish; stem short, stout, obconic, solid, 2–4 cm. long by 1–3 cm. wide, subattenuate below and largely buried in the sand, so that the pileus seems to rest on the ground, smooth, concolorous with pileus; teeth terete, slender, tapering, acute, subtriangular in cross-section at the base and coalescent so that when the teeth are broken away they leave an anastomosing network of low irregularly thickened ridges, interior darker than the outside and subtranslucent, color of surface whitish to cinereous, subdecurrent, 2–6 mm. long, 0.25–0.35 mm. wide, 3 or 4 to one millimeter; spores white to pale yellow, subglobose, tuberculate, 3–3.5 $\mu$ wide; taste mild; odor not distinct.

HAB.: On the ground in dry sandy pine woods, more or less covered with leaves, pine needles, and sand so as to be unnoticeable. Nov.

RANGE: New Jersey, *Copp.*

EXSICC.: Ellis N. Am. Fung. 929.

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* From this point the synopsis is not very satisfactory as the species are not well understood and there are many forms that require more careful field work.

The type of this species is a plant of the Ellis collection at the New York Botanical Garden and marked "3716 *Hydnum fragile* Fr. det. Cooke." The above description was written partly from the dried plant and partly from notes of Ellis made on the fresh plants collected at Iona, N. J. Ellis first referred these plants to "*H. laevigatum* Fr." but afterwards, perhaps by the influence of Cooke, referred them to *H. fragile* Fr. and under the latter name they were distributed in his N. Am. Fung. as No. 929. The plant, however, appears to be a very distinct thing. It is the only fleshy species I know of with pale tuberculate spores, and in some of its characters it appears to stand intermediate between the genus *Hydnum* and the genus *Sarcodon*. The tuberculate feature of the spores, the fibrous somewhat tough character of the flesh, together with the general habit of the plant point to its affinities with the latter genus. In the dried specimens the anastomosing ridges connecting the base of the teeth is a very marked and constant character and suggests the specific name.

Only the one collection is known. The color and habit of the plant are likely to cause it to be overlooked.

### 2. **Sarcodon cristatus** (Bres.)

*Hydnum cristatum* Bres.; Atkinson, Jour. Myc. 8: 119. 1902.

Plants terrestrial, mesopodous, yellowish 6–10 cm. high; pileus convex to subplane, more or less uneven, irregular, 3–10 cm. wide; margin subrepand, sterile; surface densely velvety tomentose to strigose hairy, in the latter case the hairs forming more or less anastomosing ridges or crests, the hairs usually branching, disc often floccose, color tan or ochre yellow, at margin lighter to whitish; substance fleshy to somewhat tough, pale brown; stem stout, solid, subcylindrical or tapering somewhat to the base, subvelutinus or with spine-like crests of strigose hairs, tawny, 1–5 cm. long by 1–2 cm. wide; teeth slender, terete, even, obtuse, decurrent, tawny olive to fuscous becoming dark brown with whitish tips in drying, "3–6 mm. long," when dried 2–3 mm. long by 0.1–0.3 mm. wide, 2 or 3 to one millimeter; spores subglobose, tuberculate with small warts, 4–5 $\mu$ wide, "tawny olive on paper"; taste acrid.

HAB.: Ground in mixed woods. Aug.–Sept.

RANGE: Connecticut, *Earle 1113;* Long Island, N. Y., *Peck and Earle 880;* New Jersey, *Ellis;* North Carolina, *Atkinson, 11127.*

The type specimens, which are from North Carolina, *Atkinson*, have the surface of the pileus covered with reticulate ridges which on their upper edges break up into coarse, strigose, branched, hair-like processes. Plants found at Port Jefferson, L. I., *Peck and Earle 880*, differ from the above in having this characteristic reduced to a fine, soft, velvety tomentum, but careful examination shows it to be essentially the same structure. The plants of both the above collections appear in the dried state, light brown in color with little or no tinge of yellow. Similar plants found formerly by Peck in this same locality were referred to *Hydnum mirabile.** But that species is described as having the lower part of the pileus and the stem woody to corky, whereas in the present plants there is no doubt of its fleshy character although the stem dries quite hard. The difference in texture between the upper and lower strata of the pileus does not appear so conspicuous a feature as Fries's figure and description would lead one to expect. In our plant the tomentose feature appears to be wholly superficial.

Specimens in the Ellis collection from New Jersey under the herbarium name *Hydnum ochroleucum* † have the tomentum of the pileus intermediate in coarseness between the type specimens and *P. & E. 880*. The color of the dried plants also is decidedly yellowish or ochraceous brown, as though this feature for some reason had been better preserved in drying.

There seems good reason, as was suggested by Peck, to refer these plants to *Hydnum acre* Quél. The only marked difference I find in the descriptions is that the European plant is smaller. But in the absence of authentic specimens of the latter plant it seems best to treat *S. cristatus* (Bres.) as a good species.

### 3. **Sarcodon scabripes** (Peck)

*Hydnum scabripes* Peck, Rept. N. Y. State Mus. Nat. Hist. 48 : 111. 1895.‡

Plant terrestrial, mesopodous, medium to large size; pileus subregular to reniform, in large specimens sometimes lobed, convex, slightly depressed at center, 3–7 × 4.5–7.5 cm. wide; surface even, subpuberulent to glabrous, light gray, usually with a pinkish

* Rept. N. Y. State Mus. 50 : 111.

† I cannot find that this name has ever been published.

‡ Two editions of this report were issued, with different pagination. The second edition in quarto is more commonly met with.

tinge more pronounced toward center; margin strongly decurved, thin, acute, sterile; substance fleshy, brittle, whitish turning dark to nearly black when bruised, 1–1.5 cm. thick near center; stem short, stout, solid, terete, or compressed, somewhat swollen toward base, inclined, excentric to lateral, concolorous with pileus becoming darker toward base, scabrous dotted with abortive teeth; teeth short, stout, terete, subacute, irregular in length, uniformly short to lacking toward margin, decurrent becoming abortive, pale-gray to whitish turning dark when bruised, 1–5 mm. long, 1 and 2 to one millimeter; spores brown, tuberculate, uniguttulate, subglobose to ovoid, 7–7.5 × 7.5–9 $\mu$; taste mild, agreeable.

HAB.: Under hemlock and oak trees. Aug.–Sept.

RANGE: New York, *Peck, Banker.*

The type specimen is larger than those described above, being 10–12 cm. wide. It is but just to say that Dr. Peck does not think the above described plants represent his species, but except in size I cannot distinguish any essential difference. It is wholly unlike anything I have seen and is evidently a good but rare species. As the plant is large and conspicuous in appearance it seems remarkable that it has not been more often found.

### 4. **Sarcodon Blackfordae** (Peck)

*Hydnum Blackfordae* Peck, Bull. Torrey Club **33**: 218. 1906

Plant terrestrial, mesopodous, medium size; pileus fleshy, convex, 2.5–6 cm. wide; surface glabrous, even, grayish or greenish gray, sometimes slightly pinkish, becoming dark in drying; substance fleshy, whitish with reddish stains, slowly becoming darker on exposure; stem equal or slightly tapering downward, solid or stuffed, becoming hollow in drying, glabrous, colored like the pileus, subcentral, 2.5–4 cm. long, 3–4 mm. thick; teeth subulate, yellowish-gray, becoming brown with age or in drying, 2–5 mm. long; spores brown, subglobose, tuberculate, 8–10 $\mu$ broad.

HAB.: Mossy grounds in low wet woods.

RANGE: Massachusetts, *Blackford.*

Only the type plants at Albany are known.

### 5. SARCODON FULIGINEO-VIOLACEUS (Kalch.) Quélet, Ench. Fung. 189. 1886.

*Hydnum fuligineo-violaceum* Kalch.; Fries, Hym. Eur. 602. 1874

Plants terrestrial, gregarious, small, 3–4 cm. high, brownish; pileus subconvex, uneven, subirregular, 4–6 cm. wide; margin

thin, sterile, decurved; surface subpubescent to smooth, sometimes with small innate scales, light brown or ochraceous brown with darker areas; substance fleshy, somewhat tough, light brown, lighter than the surface; stem subflexuose, somewhat inclined, excentric to central solid, subeven, abruptly narrowing below to a slender root-like base, 2–2.5 cm. long, 1–1.5 cm. wide; teeth fine, terete, tapering, decurrent more or less scatteringly to the root-like base, seal brown to flesh color at the tips, when dry a uniform tawny brown, short teeth scattered about among the long, 1.5–2 mm. long, 0.1–0.2 mm. wide, 3 or 4 to one millimeter; spores subglobose, tuberculate, 4–5.5 $\mu$ wide, brown; taste mild; odor of slippery elm.

HAB.: In dry mixed woods. July–Oct.

RANGE: Connecticut, *Earle 580;* New York, *Banker 724;* New Jersey, *Ellis.*

ICON.: Kalchbrenner, Icon. Hym. Hung. *pl. 32. f. 2.*

The type specimen is European. The American plants differ from Kalchbrenner's figure and description only in color, being of a tawny or ochraceous brown to umber rather than "fuligineo-violascens cum tinctura passim vinoso-rubella." But Ellis notes in his specimens "a slight purplish tinge to the pileus" and says the flesh has a "slight violet tint when freshly broken." This seems to confirm our determination of the plant as Kalchbrenner's species. Ellis regarded the plant as an undescribed species, but I do not find that he ever published it. Bresadola* says that Kalchbrenner's figure is poorly colored and rather represents *Hydnum amarescentem* Quél. His own figure does not so well represent our plant either in color or form.

The radicating stem is a very marked feature of the plant. Specimens occasionally show a tendency to develop scales. Ellis remarks that the plant "is about the size and much resembles *H. imbricatum*," doubtless having reference to the plant described in this paper as *S. Fennicus* Karst. The plant does have a close resemblance to the latter species, and in New York I found the two species closely associated, but *S. fuligineo-violaceus* was quite distinct and definitely smaller in size.

6. SARCODON LAEVIGATUS (Sw.) Karsten, Rev. Myc. $3^1$: 20. 1881.
*Hydnum laevigatum* Swartz, Kongl. Vetensk. Acad. Handl. **1810**: 243. 1810

* Fung. Trid. 2: 32. *pl. 139.*

Plants very large, low and broad, terrestrial, light to dark brown, 4–6 cm. high; pileus convex to depressed, subplane, irregular, somewhat uneven, sometimes confluent, 6–15 cm. wide; margin subrepand, thin, decurved, fertile; surface smooth, subpubescent, or obscurely scaly toward the center, sometimes subareolate by reason of superficial cracks, light to dark brown or fuscous; substance fleshy, fragile to somewhat tough, thick, nearly equal to the length of the teeth, pale brown, when dried often peculiarly light, soft and pithy; stem short, stout, somewhat inclined, uneven, excentric, solid, subbulbous, 3–5 cm. long, 1–2 cm. wide, concolorous with pileus or lighter; teeth coarse, slender, terete, tapering, subacute, slightly flexuose, smaller teeth scattered among the larger, subdecurrent, brown to cinereous with whitish tips, 3–10 mm. long, 0.3–0.7 mm. wide, 1 or 2 to a mm.; spores subglobose, very coarsely tuberculate, 5.5–8 $\mu$ wide, dark colored.

HAB.: On ground in woods. Aug.–Mar.

RANGE: Pennsylvania, *Jefferis, Schweinitz;* West Virginia, *Beardslee 588;* North Carolina, *Memminger, Schweinitz;* Alabama, *Earle, Lee, Baker.*

ICON.: Barla, Les Champ. de la Prov. de Nice, *pl. 38. f. 5, 6;* Bresadola, Fung. Trid. *pl. 138;* Fries, Sverg. ätl. Svamp. *pl. 81.*

The plants of the quoted collections vary greatly among themselves, but appear to possess no uniform characteristics by which the group can be further divided. They agree in being large, short-stemmed, with broad pilei, coarse teeth and brown color.

A puzzling fact in connection with the above collections is that the collectors themselves frequently refer their specimens to *S. subsquamosus* or even to S. *imbricatus*, which would indicate that at least in the fresh state the pileus shows some indications of scales, but there are usually no signs of scales in the dried specimens. In two or three plants of Earle's Alabama collections the central part of the pileus appears to be marked by superficial cracks into large areolae which in the fresh plant may have appeared as scales, but Swartz in his original description says "laevis nec squamosus, *medio subinde rimosus.*" [The Italics by Swartz.] We are inclined to believe, therefore, that these plants really pertain to Swartz' species.

Several of the specimens have a remarkably light soft pithy substance when dried. Whether this indicates a specific distinction or is simply a growth character cannot be determined without

more careful field notes, which in this group of plants are particularly lacking.

The plant appears to be chiefly southern in its distribution, which accounts for its remarkable seasonal range. In Alabama the fleshy fungi are most luxuriant in December and January.

7. SARCODON IMBRICATUS (L.) Karsten, Rev. Myc. 3[1]: 20. 1881.

*Hydnum cervinum* Persoon, Obs. Myc. 1: 74. 1796.
*Hydnum imbricatum* L. Sp. Pl. 2: 1178. 1753.
*Phaeodon imbricatus* Schroeter, Krypt. Fl. von Schles. 3: 460. 1888.

Plants terrestrial, mesopodous, light to dark brown or fuscous, large, 5–10 cm. high; pileus broad, subplane, depressed, subeven, somewhat irregular, 5–10 cm. wide; margin thin, decurved, fertile, subrepand; surface subpubescent, scaly, scales larger and thicker toward center of disk usually wanting toward margin, 2–8 mm. wide, subimbricate, often zonately arranged, pale brown to dark brown, darker on the scales; substance fleshy, pale brown to whitish; stem stout, usually uneven, often inclined, more or less excentric, solid or perforate, concolorous with pileus, 2–9 cm. long, 1.5–3 cm. wide; teeth coarse, terete, tapering, acute, sometimes forked; usually decurrent, brown, light brown or cinereous, 1–10 mm. long, 0.25–0.7 mm. wide, 1 or 2 to one millimeter; spores subglobose, tuberculate, 5.5–7 $\mu$ wide, brown.

HAB.: In woods. July–Aug.

RANGE: Connecticut, *Underwood & Earle 1154;* New York, *Peck;* Alabama, *Underwood & Earle, Burton;* Wyoming, *Nelson 4197;* Montana, *Tweedy 6.*

ICON.: Barla, Les Champ. de la Prov. de Nice, *pl. 38. f. 1–4;* Fl. Dan. *pl. 176;* Harzer, Naturg. Abb. der Pilze, *pl. 3. f. 6–8;* Fries, Sverig. ätl. Svamp. *pl. 33:* Patouillard, Tab. Analyt. Fung. *pl. 245;* Greville, Scot. Crypt. Fl. *pl. 71;* Atkinson, Mushrooms, etc., ed. 1900; *f. 189; Idem*, ed. 1901; *f. 200;* Dietrich, Forstflora, ed. 1840; 2: *f. 187; Idem*, ed. 1860; 2: *pl. 291. f. 2.*

EXSICC.: Krieger, Fung. Sax., 419; Linhart, Fung. Hung., 347; Roumeguere, Fung. Select. Exsicc., 5328; Sydow, Myc. March., 105; Herpell, Samml. präp. Hutp., 75.

The plants referred to this species present considerable variation and the segregation here effected is not wholly satisfactory. They

agree in the large size, stout stems, coarse teeth, broad pilei, and distinct imbricate scales of the pileus. If it were not for the latter character many of the plants could not be separated from forms of *S. laevigatus* and the group presents much the same difficulties as were met with in that species. As the presence or absence of scales on the pileus appears to be an artificial distinction, it is possible that a more thorough study of the forms of these related species will show that the true line of specific cleavage must ignore this character. In the collections quoted not a single field note has been made and the description has been prepared entirely from the dried specimens. It is undoubtedly too broad. Many of the plants appear to be sufficiently marked as to warrant their being regarded as distinct species. But with such meager material and no field notes it does not seem best to attempt a specific description. Some of the conspicuous distinctions may be noted as follows: "Ala. U. & E.," teeth not at all decurrent; "Nelson, 4197," stem hollow and scaly within; "Tweedy, 6," remarkably thick prominent scales. I regard the Connecticut and New York specimens as typical examples of *S. imbricatus* The fact is *S. imbricatus* is not so common in this country as has been supposed and the forms so commonly referred to that species need to be more critically studied in the field. Besides peculiarities of scales and teeth it should also be noted before drying whether the stem is solid, stuffed, or hollow as in drying it frequently becomes excavated and so appears to be hollow.

The European icones quoted are the most uniform and satisfactory of the many examined but even then some notable differences are to be observed. Barla represents a plant with violaceous teeth and stem and Fries shows a hollow or perforate stem. Fries' figure differs from Nelson's plant in its much longer stem. Atkinson's figures are not very satisfactory; they appear to represent a deformed rather than a typical plant.

Of the Exsiccati the most satisfactory are Krieger, Herpell, and Linhart. Ellis, N. Am. Fung. 926, appears to be made up of different things some of which may constitute a distinct species.

8. SARCODON FENNICUS Karsten, Rev. Myc. 9: 10. 1887.

*Sarcodon scabrosus fennicus* Karsten, Ryssl. Finl. och den Skand. Half. Hattsv. 2: 104. 1882.

*Hydnum fennicum* Sacc. Syll. Fung. **6**: 433. 1888.
*Phaeodon fennicus* Hennings, Die Natürl. Pflanzenf. $1^{1**}$: 149. 1898.

Plants terrestrial, mesopodous, somewhat gregarious, medium size, reddish brown or purplish; pileus convex, subumbilicate, slightly uneven, 4–8 cm. wide; margin thin, fertile, inflexed; surface broken up into small thick scales which are arranged in more or less concentric and radiating lines, scales diminishing in size toward the margin, from 5 mm. wide to floccose points, color of pileus dark brown to reddish brown or purplish darker on the scales; substance fleshy, fibrous, brittle, light brown (when dried fibrous, pithy, opaque, light brown); stem subflexuose, usually strongly inclined, attenuate to the base, concolorous becoming very dark at the base, solid, 4–6 cm. long, 8–15 mm. wide; teeth terete, slender, acute, scatteringly decurrent, dark umber at base to whitish at tips, 3–4 mm. long, 0.2–0.3 mm. wide, but with many minute teeth scattered irregularly among the others; spores subglobose, tuberculate, 6–7 $\mu$ wide, brown; taste bitter.

HAB.: On ground in mixed woods. Aug.–Oct.

RANGE: Massachusetts, *Seymour;* New York, *Banker 735, Peck;* New Jersey, *Ellis;* Kentucky, *Morgan;* Tennessee, *Murrill.*

The plant has been usually referred to *S. imbricatus* on the basis of its scaly pileus but it differs from that species in its smaller size, more slender stem, finer teeth, reddish color, and the dark usually bluish base of the stem. Many of the specimens distributed by Ellis in N. Am. Fung. under No. 926 (*H. imbricatum*) apparently belong to this species.

### 9. **Sarcodon Underwoodii** sp. nov.

Plant terrestrial, mesopodous, small to medium size; pileus subplane, depressed, irregular, 6–10 cm. wide; margin thin, inflexed, fertile with short teeth; surface covered with small narrow scales more or less floccose toward margin, mostly 1–2 mm. wide, ends upturned, subzonately arranged, color pale brown or tan, somewhat darker on the scales, grayish brown toward the margin; substance fleshy, whitish, drying thin (less than 1 mm.), hard, dark, brown to black, subtranslucent; stem irregular abruptly tapering and radicating below, subconcolorous, scaly and roughened above by scattered spines, 3–5 cm. long, 1–3 cm. wide; teeth small, slender, terete, acute, crowded, decurrent, scattered nearly to base of stem, pale cinereous nearly white, light brown when dry, 2–3 mm. long, 0.5 mm. wide, in dried plants less than 2 mm. long, capil-

lary, 4 to 6 to one millimeter; spores globose, tuberculate, 5–6 $\mu$ wide, dark colored; taste bitter.

HAB.: Ground in dry woods. July–Oct.

RANGE: Connecticut, *Underwood and Earle 598;* New Jersey, *Ellis, Gentry.*

The type specimens are the *U. & E. 598* at the New York Botanical Garden. The plant is closely related to *S. fennicus* Karst. differing from that species in its radicating stem, the finer teeth and the dark horny appearance of the flesh when dried; the dark color at the base of the stem also appears to be lacking. The teeth in the dried plant are very brittle so that herbarium specimens are often denuded. The plant has been generally referred to *S. imbricatus* but its only claim to such disposition is the fact that it has a scaly pileus. One set of Ellis N. Am. Fung. contained a large specimen of this species under 926 (*H. imbricatum* L.)

### 10. **Sarcodon atroviridis** (Morgan)

*Hydnum atroviride* Morgan, Jour. Cin. Soc. Nat. Hist. **18**: 38. 1895.

*Phacodon atroviride* Earle; Mohr. Pl. Life Ala. 205. 1901.

Plants terrestrial or lignatile, mesopodous, very dark, blackish or olivaceous, small, 1–3 cm. high; pileus convex to expanded, thin somewhat irregular, umbonate, 1–2 cm. wide; margin thin, fertile with short teeth; surface subpubescent to glabrous, dark olivaceous brown to blackish; substance "fleshy-coriaceous"; stem slender more or less deformed, often attenuate below, central or excentric, 1–2 cm. long, 0.2–0.3 cm. wide; teeth short, slender, acute, crowded, not decurrent, at first light grayish white becoming dark brown with age, 1–2 mm. long, 0.2–0.3 mm. wide, 3 or 4 to a mm.; spores globose to ovoid, tuberculate, dark fuscous or olivaceous, 4.5–7 by 7–8 $\mu$ wide.

HAB.: On ground in woods or on old wood. Sept.

RANGE: Alabama, *Atkinson, Earle.*

ICON.: Morgan, *loc. cit. pl. 1. f. 5.*

The type specimens which are in Morgan's herbarium were collected by Atkinson "on old wood," an unusual habitat for this genus. They were said to be dark green throughout even to the spores. Earle's plants were found on the ground in woods. No greenish color was observed about these plants when fresh, but

the dried plants appear dark olivaceous brown to black. On comparing the specimens, however, there appears to be no doubt as to the identity of the two collections.

SPECIES DUBIAE ET INQUIRENDAE

*Hydnum canum* Schwein. Syn. Fung. Car. 77. 1818.

The specimen in the Schweinitz herbarium throws little light on this species as it is a mere fragment and suggests a tough coriaceous plant rather than a fleshy one. Fries treated the species as a synonym of *H. gracile* and Schweinitz himself* expressed doubt as to the validity of the species.

*Hydnum Curtisii* Berkeley, Grevillea, 1: 71. 1872. South Carolina, *Curtis, 2809*. This is the type specimen which I have not seen. A plant found by Earle in Alabama answers in every particular to the description but looks as though it might be a young plant of *S. laevigatus* (Sw.) Karst.

The following European species have been reported from this country but for various reasons are excluded from the present enumeration: *H. subsquamosum* Batsch. has been reported several times. New England, *Sprague;* Rhode Island, *Bennett;* Pennsylvania, *Schweinitz;* South Carolina, *Curtis, Ravenel;* Alabama, *Peters*. Bennett's specimen is a tough coriaceous plant evidently closely related to *H. zonatum* Batsch. Schweinitz's specimen has been referred in this paper to *S. laevigatus* (Sw.) Karst. there being no scaliness to the pileus. The other collections have not been seen. *H. infundibulum* Swartz, has been reported from Pennsylvania, *Schweinitz;* Ohio, *Lea, Morgan;* Kentucky, *Morgan*. Schweinitz's specimen is too nearly destroyed to furnish any satisfactory idea of the plant. Morgan's Kentucky specimens may be of this species but seem very small. The Ohio specimens I have not seen. *H. fusipes* Pers. Pennsylvania, *Schweinitz*. The specimen appears to be a small or young specimen of *S. fuligineo-violaceus* (Kalch.) Quél. *H. versipelle* Fr. New York, *Fairman*. The specimen appears to be a young plant of *S. Underwoodii*.

6. HYDNELLUM Karsten, Medd. Soc. Faun. et Fl. Fenn. 5: 27. 1879

*Calodon* Quélet; Karsten, Rev. Myc. 3[1]: 20. 1881.

* Syn. N. Am. Fung. 161.

Plants chiefly terrestrial, mesopodous, often deformed, usually dark colored, brown, reddish to orange, sometimes whitish; substance fibrous, tough, sometimes compact, hard and woody, often in two layers the outer felt-like, soft, tomentose, the inner compact, hard; spores colored, coarsely tuberculate.

The species of this genus were originally placed by Fries in his tribe Mesopus, section Lignosa, which was made to include all tough mesopodous species of the Hydnaceae. In 1878 Quélet* proposed to raise the whole group to the rank of a genus and suggested the name *Calodon* but failed to establish the genus according to present methods. The next year Karsten, *op. cit.*, independently took up the same group raised it to generic rank and gave it the name *Hydnellum* making the proper binomial combinations which established the genus. In 1881 the last named author *op. cit.* divided the group into the white toothed and the dark toothed forms and to the former gave the name *Phellodon q. v.* but for the latter, rejecting his own well established name *Hydnellum*, he took up *Calodon* proposed by Quélet, and gave it nomenclatural standing; in which he appears to have been influenced too much by his respect for others. As Karsten's original work is logical, accurate, definite, and when he is not following others, is based on sound nomenclatorial principles, it seems right that his name should prevail.

**Synopsis of the Species**

Plants exuding red juice when injured.
- Plants fragrant, acrid, whitish or pale brown; surface of pileus azonate, subeven, scarcely depressed. 1. *H. Carbunculus.*
- Plants odorless, mild, reddish-brown; surface of pileus subzonate to azonate uneven, depressed to infundibuliform. 2. *H. sanguinarium.*

Plants not exuding red juice when injured.
- Surface of pileus distinctly zonate, margin whitish or pink.
  - Plants small, less than 4 cm. wide; pileus very thin. 7. *H. zonatum.*
  - Plants larger, 3–15 cm. wide; pileus thicker. 6. *H. concrescens.*
- Surface of pileus azonate or obscurely zonate, color more or less uniform or irregularly blotched.
  - Plants with more or less of orange in their color, often complicated, irregular.
    - Plants large, more than 4 cm. wide, terrestrial. 8. *H. floriforme.*
    - Plants small, less than 3 cm. wide, on cones. 9. *H. conigenum.*
  - Plants with more or less of blue in their color, not complicated.
    - Plants large, more than 6 cm. wide, whitish, horizontally zonate internally with blue, fragrant. 13. *H. suaveolens.*

*Clav. Hym. 196.

Plants small, rarely more than 6 cm. wide, drab with bluish margin; odor slight. 14. *H. cyaneotinctum.*

Plants without orange or blue; usually brown or pallid, or brick-red.

Pileus smooth, lobed, more or less complicated. 10. *H. complicatum.*

Pileus pubescent, subregular, sometimes complicated in no. 5.

Pileus of two distinct layers, the upper felty the lower compact.

Plant brown; pileus obscurely zonate; substance hygrophanous. 5. *H. scrobiculatum.*

Plant uniform cinnamon brown; stipe subcentral, substance dry.

Pileus convex; teeth stout, 0.3 mm. wide. 3. *H. velutinum.*

Pileus depressed to infundibuliform; teeth capillary, 0.2 mm. wide. 4. *H. Nuttallii.*

Plant more or less brick red, stipe lateral or sublateral. 11. *H. Earlianum.*

Substance of pileus uniform, spongy when fresh; plant large, 5–8 cm. wide, yellowish brown. 12. *H. humidum.*

### 1. **Hydnellum Carbunculus** (Secr.)

*Hydnum Carbunculus* Secr. Myc. Suis. **2**: 515. 1833.

Plants terrestrial, mesopodous, gregarious, more or less confluent, low, appearing nearly sessile, broad; pileus convex to plane, rarely slightly depressed in center by no means infundibuliform, more or less uneven, not colliculose, somewhat round or irregular, 4–10 cm. wide and by confluence often 20 cm. wide; surface woolly-pubescent, often more or less floccose squamulose, azonate, whitish at first turning light brown to whitish, with irregular blotches of dark brown to nearly black where bruised or touched, these latter more or less glabrous, shining, probably from the dried juice; substance fibrous, tough, spongy, drab in the upper part of pileus, compact, hard, somewhat woody, more or less distinctly zonate in the lower part, exuding a thick red juice in the fresh plant; margin somewhat thick, obtuse, subfertile to sterile; stem stout, very short, deformed, becoming bulbous in the substratum, and sometimes subradicating, 1–3 cm. wide, 1 mm.–1 cm. long above ground; teeth slender, terete, acute, decurrent, pinkish-white, less than 5 mm. long shortening to the margin about 2 to one millimeter; spores ovoid, tuberculate, brownish, 4–5.5 $\mu$; odor of hickory nuts, strong; taste intensely acrid.

HAB.: On ground among pine or spruce needles, usually in sand. Sept.–Dec.

RANGE: Maine, *White*; New Jersey, *Ellis*; Maryland, *Shear;* Alabama, *Earle.*

EXSICC.: Ellis N. Am. Fung. 928, as *Hydnum ferrugineum;* Ellis and Everhart, Fung. Columb. Cont. Shear, 1409, as *Hydnum ferrugineum.*

The Ellis plants found in N. Am. Fung. 928, do not appear to be typical specimens differing chiefly in color and character of tomentum but are referred here for the present. They do not give any odor in the dried state whereas the odor of the other specimens quoted is very persistent.

Secretan claimed his species to be the same as *Hydnum ferrugineum* Fries, but his description does not seem to correspond well either with Fries' description or figure, while the plants above described correspond to Secretan's description in nearly all characters. These plants have usually been referred to *Hydnum ferrugineum* Fries (see next species).

### 2. **Hydnellum sanguinarium** nom. nov.

*Hydnum ferrugineum* Fries, Obs. Myc. **1**: 133. 1815. Not *H. ferrugineum* Pers. Tent. disp. meth. Fung. **30**: 1797.

*Phaeodon ferrugineus* Schroeter, Krypt. Fl. von Schles **3**: 459. 1888.

*Calodon ferrugineus* Karsten, Rev. Myc. $3^1$: 20. 1881.

*Hydnellum ferrugineum* Karsten, Medd. Soc. Faun. et Fl. Fenn. **5**: 27. 1879.

Plant terrestrial, mesopodous, subgregarious, medium size; pileus obconic, expanded, depressed to subinfundibuliform, irregular, more or less deformed, 5 cm. wide, center of disk a mass of irregular tubercles and subfertile pileoli, becoming radiating ridges toward the margin; surface densely pubescent to hirsute, shades of umber or reddish-brown throughout, sometimes obscurely zonate; margin obtuse, sterile, with blackened glabrous spots; substance spongy-fibrous toward the top of pileus, concolorous with surface of pileus, harder and darker below and through the center of the stem transversely zonate, exuding red juice where injured; stem stout, irregular, more or less deformed, surrounded toward the base by a mass of spongy tomentum, solid, 3–4 cm. long, 1–1.5 cm. thick; teeth short, terete or flattened, often concrescent, sometimes forming lamellae and pseudopores, decurrent to the tomentum of the base, surface puberulent, less than 3 mm. long; spores subglobose to ovoid, coarsely tuberculate, 4–5 $\mu$ wide; taste mild.

HAB.: On ground in dry woods. Aug.–Sept.

RANGE: Canada, *Dearness;* Maine, *White;* Vermont, *Hadley;* Connecticut, *Earle 1194;* New York, *Earle;* New Jersey, *Ellis;* District of Columbia, *Billings.*

ICON.: Fries, Icon. Select. Hym. *pl. 4.*

The species may be distinguished from related species with which it is likely to be confused by its red juice, from *H. Carbunculus* Secr., which also has red juice it may be readily distinguished by its lack of odor and mild taste. But unfortunately these characters are indeterminable in the dried plants and it is then very difficult to say with certainty to which of several species a given specimen may belong. A considerable number of collections have had to be set aside, as in the dried state, with no notes on the fresh characters, it was impossible to decide with any degree of satisfaction whether the plants represented *H. sanguinarium*, *H. concrescens*, *H. scrobiculatum*, or some undescribed form. In fact, the distribution as given above must be regarded as subject to some uncertainty. It is probable that specimens of this species are commonly referred to *Hydnum scrobiculatum* Fries, but a red juice has never been ascribed to that species. Our plants conform well to figures and descriptions of *Hydnum ferrugineum* Fries, but are rarely so large as that plant is represented. A specimen received from Bresadola presents characters intermediate between the above species and *H. Carbunculus*, having the odor and whitish pubescence of the latter, and the depressed colliculose pileus of the former. It may be that the European plant is distinct from either of our American forms. Observations on the fresh plants, including taste, odor, and character of juice, are very desirable.

*H. ferrugineum* Fries is preoccupied by *H. ferrugineum* Pers., a resupinate plant, and therefore the name must be changed.

### 3. **Hydnellum velutinum** (Fries)

*Hydnum velutinum* Fries, Sys. Myc. **1**: 404. 1821.

*Calodon velutinus* Karsten, Ryssl. Finl. och den Skand. Half. Hattsv. **2**: 109. 1882.

*Hydnum spongiosipes* Peck, Rept. N. Y. State Mus. Nat. Hist. **50**: 111. 1897.

Plants terrestrial, mesopodous, low, broad, dark brown throughout, gregarious, sometimes confluent; pileus obconic, subrotund, slightly irregular, strongly convex, center often depressed, 1–10 cm. wide; surface finely tomentose to pubescent, subeven, or occasionally radiately subrugose, azonate, rarely a single concentric

groove, uniform cinnamon brown; margin subdeflexed, thin, even, substerile, occasionally with dark glabrous places; substance felty-tomentose, cinnamon-brown in the upper part of pileus, hard, compact and darker in the lower part and extending through the central part of stem, dry; stem short, conic, 1 cm. long, 1.5–2.5 cm. wide, surrounded at base by a dense mass of felty tomentum similar to upper part of pileus, penetrating the substratum and often as large or larger than the pileus; surface finely tomentose, concolorous with pileus; teeth terete, slender, straight, tapering, acute, the longest midway from margin to stem, decurrent to the bulbous base, uniform dark or light brown, lighter at the tips, puberulent, 1–5 mm. long, 0.3 mm. wide, 2 to one millimeter; spores subglobose, coarsely tuberculate, 4–4.5 $\mu$ wide.

HAB.: On ground in dry woods. July–Oct.

RANGE: Connecticut, *Underwood and Earle 1093;* New York, *Banker, Peck & Earle 861, Atkinson, Cushier;* New Jersey, *Ellis;* Delaware, *Commons;* North Carolina, *Atkinson;* Alabama, *Atkinson;* West Virginia, *Nuttall 880;* Ohio, *Morgan.*

ICON.: Patouillard, Tab. Analyt. Fung. *f. 677;* Gillet, Les Champ. de France, *pl. 324.*

The above collections all represent the plant described by Peck and named *Hydnum spongiosipes.* I have long hesitated on the question whether the latter name should be regarded as a synonym of *H. velutinum* Fries or stand as a valid species. Saccardo's account is copied from Fries' *Hymenomycetes Europaei* and does not fit our plant in several particulars. The original description in the *Systema Mycologicum,* however, more nearly corresponds to our plant differing only in the following points. Fries says "Substantia azona"; our plant often shows obscurely internal zonations; "pileus 0.5–1 unc. latus"; our plants will average 3–5 cm. wide; but perhaps most important Fries asserts "pileo infundibuliformi" and cites "Mich. gen. t. 72. f. 4." with the remark "icon bona," a figure which shows a very deeply infundibuliform plant, while our plant rarely is found even markedly depressed, never infundibuliform. On the other hand Fries mentions in the original description but not in his later work, with respect to the stem "tomento demum spongioso vestitus," a conspicuous and characteristic feature of our plant to which Peck in his description of *H. spongiosipes* calls special attention. Finally while the figures quoted by Fries as representing his plant all show a plant in-

fundibuliform and otherwise unlike ours, the figures in European icones drawn later as actual representations of *H. velutinum* Fries are excellent figures of our plant in all particulars. As it appears from Patouillard and Gillet's figures and from the descriptions accompanying them that *H. spongiosipes* Peck is a plant also found in Europe, the question is, did Fries really describe that plant as *H. velutinum?* It appears to me that in the absence of authentic specimens of *H. velutinum* Fries for comparison, the weight of evidence is that *H. spongiosipes* Peck is too near *H. velutinum* Fries to warrant its recognition as a distinct species.

The plant is quite common with us and maintains fairly constant characters. It can be readily distinguished from closely related species by its uniform brown color, convex or plane pileus, and its dry substance in two distinct layers.

### 4. **Hydnellum Nuttallii** sp. nov.

Plant terrestrial, mesopodous, medium size; pileus obconic, deeply depressed to infundibuliform, somewhat round, thickest at the center, thinning uniformly to the margin, 4–6 cm. wide, 1 cm. or less thick near the center; surface subeven, radiately subrugose or fibrillose when fresh, grayish umber; margin thin, acute, coarsely plicate or fluted, deflexed, curled when dried, subfertile with short teeth; substance spongy-tomentose in upper half of pileus, thickest at the center, umber, lower part of pileus harder more compact darker of uniform thickness about 1 mm., continuous with hard central core of stem; stem central, uneven, surrounded below by bulbous mass of spongy tomentum, 0.5 cm. wide, 4 cm. long, bulbous base 1.5 cm. wide; teeth capillary more or less decurrent, dark umber to black, 7 mm. or less long, 0.15–0.25 mm. wide, about 2 to one millimeter, longest teeth about one fourth of the distance from the stem to the margin; spores apparently few, subtuberculate, subglobose, brownish, 4–5 $\mu$ wide.

HAB.: On ground in woods. May–July.

RANGE: New York, *Peck;* West Virginia, *Nuttall 844;* North Carolina, *Atkinson 4340.*

Nuttall's 844 in the New York Botanical Garden is the type of the species. The plant in structure is similar to *H. velutinum* but very distinct in the form of the pileus, in its subrugose not tomentose surface, and in the long capillary teeth. Atkinson 4340 differs in some respects from the type but in characters that

seem to be accounted for by the fact that the plant was old and dead when collected.

### 5. **Hydnellum scrobiculatum** (Fries)

*Hydnum scrobiculatum* Fries, Obs. Myc. 1: 143. 1815.

Plants terrestrial, mesopodous, gregarious, usually more or less confluent in masses, brown throughout; pileus subregular to irregular, expanded, obconic, subplane, somewhat depressed or rarely subconvex, 2–4 cm. wide, by confluence becoming 10 cm. wide; surface densely woolly or velvety pubescent, uneven, rugose, often colliculose and complicated by pileoli, cinnamon-brown, changeable with the light, becoming permanently dark if bruised or dipped in water which mats down the pubescence, sometimes obscurely zonate; margin repand, straight, obtuse, sterile, lighter than disk, this is more apparent if the plant be dipped in water; substance tough, fibrous, soft and spongy toward the upper part of pileus, more compact in lower part and center of stem, transversely zonate, dark brown, hygrophanous so that the juice may be squeezed out in drops, juice watery with a slight pinkish tinge; stem slender, surrounded nearly or quite to the pileus by a large mass of spongy hygrophanous tomentum which is confluent with adjoining masses, surface woolly pubescent concolorous with pileus becoming dark when bruised or wet, stem near pileus 5–8 mm. wide, 5 mm. or less long to the spongy base, base 1–2 cm. wide, stem including base 2–4 cm. long; teeth slender, terete, subcylindrical, straight, uniform in length, shortening toward margin and stem, occasionally somewhat decurrent, brown with light tips, puberulent, do not change color or become wet when dipped in water, darkening some when bruised, 3 mm. and less long, crowded, about 3 to one millimeter; spores brown, subglobose, tuberculate, uniguttulate, 3.5 $\mu$ wide; taste disagreeable but not acrid; odor of rotten wood, not strong.

HAB.: On ground in dark, damp woods. Aug.

RANGE: New York, *Banker*. Other collections referred here with some doubt owing to the lack of data as to living characters, are as follows: New York, *Cushier*, *Peck*; South Carolina, *Ravenel*; Kentucky, *Morgan*; Tennessee, *Murrill*. Besides these there are a large number of collections which may belong here in part and in part should be referred to *H. sanguinarium* or *H. concrescens* or possibly represent some other related species. But to diagnose these forms without knowing the living characters of the plants is mainly guess work. Only an expert thoroughly familiar with the

living and the dried plants could determine the species from herbarium specimens. I question even then if he would not be liable to some errors.

ICON.: Fries, Icon. Select. Hym. *pl. 5. f. 1.*

The description given above based on a large collection of material obtained by the writer in the summer of 1905 does not strictly conform to Fries' account of *H. scrobiculatum*, but so closely do our plants answer to Fries' description and figure that it did not seem wise to treat these plants at present as a new species. The most marked difference is Fries' statement "stipite brevissimo, nudo, radicato," while our plants have a noticeable stem, always surrounded by a mass of spongy tomentum.

### 6. **Hydnellum concrescens** (Pers.)

*Hydnum concrescens* Persoon, Obs. Myc. 1 : 74. 1796.

Plants terrestrial, mesopodous, gregarious, sometimes confluent, medium size, brown with light border; pileus expanded, depressed to subinfundibuliform, normally subround, but often deformed and irregular from contact with sticks and leaves of the substratum, 3–6 cm. wide; surface finely pubescent, often colliculose at center, distinctly zonate with shades of brown, darker at the center, the outer zones a light pink to whitish, the transition being very abrupt, becoming a uniform brown throughout in drying; margin somewhat thick, rounded, sterile, even; substance fibrous, tough, dry, obscurely zonate, reddish-brown; stem short, irregular, uneven, bulbous at the base with spongy tomentum, solid, light brown, finely tomentose, 1–2 cm. long, 6–10 mm. wide; teeth slender, terete, tapering, acute, decurrent, dark brown at the base lighter at the tip, less than 1.5 mm. long, about 0.2 mm. wide; spores subglobose, tuberculate, 3–4 $\mu$ wide, brown; taste slightly bitter, unpleasant.

HAB.: On ground in dry woods. Aug.

RANGE: Maine, *White;* Massachusetts, *Francis;* New York, *Banker.*

The plants included in the above species are usually referred to *Hydnum zonatum* Batsch, but they differ from that species as here interpreted in their larger size, relatively thicker pileus, and decurrent teeth. Owing to the changes which the plant undergoes in drying, especially in color, it is very difficult to separate it from related species in herbarium specimens unaccompanied by field

notes. The distribution recorded above is based on plants positively identified by the aid of reliable field notes. The following collections are also referred here, but not with certainty: Connecticut, *Underwood;* New Jersey, *Ellis;* Alabama, *Underwood.*

7. HYDNELLUM ZONATUM (Batsch) Karst. Medd. Soc. Faun. et Fl. Fenn. **5**: 27. 1879

*Hydnum zonatum* Batsch, Elench. Fung. 111. 1783.

*Calodon zonatus* Karsten, Ryssl. Finl. och den Skand. Half. Hattsv. **2**: 108. 1882.

*Phaeodon zonatus* Schroeter, Krypt. Fl. von Schles. **3**: 458. 1888.

Plants terrestrial, mesopodous, gregarious, often confluent, small, cinnamon-brown with light margin; pileus subconvex to plane umbilicate or subinfundibuliform, irregular, thin, less than 1 mm. thick, 1.5–3 cm. wide; surface radiately fibrillose-striate, subpubescent, distinctly zonate with shades of brown, darker in the center, pink to nearly white toward the margin when fresh but turning more or less uniform brown when dried; substance darker and more compact than surface layer, azonate, thin; margin thin, acute, sterile; stem slender, subcylindrical, slightly bulbous at base with scarcely evident spongy tomentum, solid, pubescent, cinnamon-brown, 1–1.5 cm. long, 2–3 mm. wide; teeth slender, terete, acute, not decurrent, dark brown, less than 1.25 mm. long, shortening towards margin and stem; spores subglobose, coarsely tuberculate, 3–4 $\mu$ wide.

HAB.: On ground in dry woods. Dec.

RANGE: New York, *Peck;* Michigan, *Gray;* Alabama, *Earle, Baker.*

ICON.: Batsch, Elench. Fung. Contin. **2**: *pl. 40. f. 224 a, b.*

As these plants conform remarkably to Batsch's figures and appear to correspond in all respects with his descriptions, I believe them to be the true *H. zonatum* of Batsch. They are not, however, the plants more commonly referred to that species (*cf. H. concrescens*). The species is readily distinguished from other species even in the dried state. It is most closely related to *H. concrescens* from which it can be distinguished by its small size, thin pileus, slender stem, and lack of tomentum. The date given is only for the Alabama plant.

### 8. **Hydnellum floriforme** (Schaef.)

*Hydnum floriforme* Schaeffer, Fung. Bav. et Pal. **4**: 97. 1774.
*Hydnum suberosum aurantiacum* Batsch, Elench. Fung. Contin. **2**: 103. 1789.
*Hydnum compactum* Persoon, Comment. Schaef. 57. 1800.
*Hydnum hybridum* Persoon, *loc. cit.*
*Hydnum aurantiacum* Albertini & Schweinitz, Consp. Fung. 265. 1805.
*Hydnum aurantinum* Rafinesque-Schmalz, Prec. des Decour. 50. 1814.
*Hydnellum aurantiacum* Karsten, Medd. Soc. Faun. et Fl. Fenn. **5**: 27. 1879.
*Calodon aurantiacus* Karsten, Rev. Myc. **3**[1]: 20. 1881.
*Phaeodon aurantiacus* Schroeter, Krypt. Fl. von Schlies. **3**: 459. 1888.

Plants terrestrial, mesopodous, somewhat gregarious, medium size; pileus somewhat round or irregular, convex, plane or depressed to subinfundibuliform, often complicated or compound, *i. e.*, consisting of several pileoli with short usually lateral stipes uniting into the common more or less central stipe, 4–11 cm. wide; surface subeven, sometimes uneven or colliculose, usually pubescent, pale brick-red, reddish-orange or dark brownish, lighter to cream-color at margin; margin thin, deflexed or obtuse, rounded, sometimes repand, sterile; substance an upper punky, pale brick-red, relatively thin layer, and a lower hard, woody, zonate, grayish-ochraceous to pale orange relatively thick layer extending into center of stem; stem central or excentric, occasionally lateral, more or less deformed, sometimes branched, usually bulbous below surrounded by a more or less compact subspongy mass, reddish yellow, pubescent, 1–3 cm. long, 0.5–2 cm. wide; teeth slender, terete, acute, decurrent umber to fuscus with light tips, sometimes deformed and coalescent, 4 mm. or less long; spores subglobose to ovoid, tuberculate, dark brown or fuscous, 4 by 4–5 wide.

HAB.: On the ground in dry woods. July–Oct.

RANGE: Connecticut, *Underwood;* New Jersey, *Ellis;* New York, *Underwood & Cook, Peck;* Alabama, *Earle & Baker.*

ICON.: Batsch, Elench. Fung. Contin. **2**: *pl. 40. f. 222;* Schaeffer, Fung. Bav. et Pal. Icon. *pl. 146.*

EXSICC.: Underwood and Cook, Century of Ill. Fung. 21.

The plants referred to the above species present a great variety

of forms so that it is very difficult to characterize the species satisfactorily, and still more difficult to distinguish it from its congeners. It possesses scarcely one invariable character that is not common to other species, still the compact woody character of the substance combined with its more or less orange tints will usually serve to distinguish the species. It has not been found possible to segregrate the many forms into any well-defined groups, and it seems necessary to regard the species as extremely variable in character. Moreover, single collections frequently show highly variable series of forms. This variable character has led to much confusion in nomenclature and in the broad view of the species taken in this paper most of the proposed species become reduced to synonymy. In fact the present treatment is practically a return to the limits set by Schaeffer.

Persoon first attempted to break up the Schaefferian group in his *Commentarius*, *loc. cit.*, dividing the species as figured by Schaeffer into two parts. Plate 146, figures 1, 2, 3, 5 and 6 he referred to *Hydnum compactum*, and plate 146, figure 4 with plate 147, figures 2–6 he referred to *H. hybridum* Bull. Later, in his *Mycologia Europeae* **2**: 166, he somewhat doubtfully returned to the Schaefferian conception but retained the name *H. compactum* for the whole aggregation. In the meantime the segregation inaugurated by Persoon had been adopted by others, notably by Fries who referred the second group of figures from Schaeffer to *H. aurantiacum* (Batsch) Alb. & Schw. but retained the first group under *H. compactum* Pers. The conception of the latter species appears to have undergone a gradual change until the name was employed to designate a very distinct plant from the species of Schaeffer. It is, therefore, evident that. *H compactum* Pers. should be treated as a synonym of *H. floriforme* Schaef. and the species now designated *H. compactum* Pers. by the European botanists doubtless should be renamed.

### 9. **Hydnellum conigenum** (Peck)

*Hydnum conigenum* Peck, Bull. Torrey Club **30**: 97. 1903.

Plants mesopodous, on cones, small; pileus obconic, subplane, even, somewhat round, 1–2 cm. wide; surface subpubescent, grayish-orange; margins sometimes split, thin, obtuse; substance com-

pact, fibrous, hard, azonate, orange-brown; stem slender, central or excentric, concolorous with pileus, bulbous at base with a compact mass of orange-colored spongy tomentum; teeth short, decurrent, whitish becoming brown; spores subglobose, colored, 4–5 $\mu$ wide.

HAB.: On fallen cones of pine. Autumn.

RANGE: Idaho, *Henderson.*

The type specimens are in the state herbarium at Albany. Only the one collection has been obtained and the above description has been drawn up largely from the original account of Peck. The species is closely related to *H. floriforme* (Schaef.) differing chiefly in its small size and peculiar habitat which is unusual in this genus.

### 10. **Hydnellum complicatum** sp. nov.

Plants terrestrial, mesopodous, complicated, medium size; pileus expanded, convex, depressed in center, subregular to irregular, lobed, and complicated, thin, rigid, 4–7 cm. wide; surface more or less uneven finely pubescent to subglabrous, cream-colored to reddish umber or purplish; margin thin, concolorous to reddish black, repand, sterile; substance fibrous compact, somewhat spongy, whitish to pale buff in upper part of pileus, harder, woody, subzonate in lower part and stem, becoming reddish toward the base; stem short, deformed, somewhat bulbous at base with a compact somewhat spongy covering, 2–3 cm. long, 1 cm. wide; teeth short, slender, terete, decurrent, cream-colored at margin to fuscous toward stem, 3 mm. long or less; spores subglobose to ovoid, finely tuberculate, fuscous, 3.5 by 4.5 $\mu$ wide; odor slight but agreeable. Sept.

RANGE: New York, *Van Hook 8191.*

The type specimens are in the herbarium of Cornell University, No 8191. The species is closely related to *H. floriforme* (Schaef.), differing chiefly in color, there being no tinge of yellow or orange, and in its smaller spores. The plant, though irregular and complicated, is more uniform and constant in its characters; the surface of the pileus as a rule is more even and smooth.

### 11. **Hydnellum Earlianum** sp. nov.

Plant terrestrial, pleuropodous or somewhat mesopodous, small; pileus expanded, convex to slightly depressed, roundish to dimidiate or reniform, 3–5 cm. wide; surface slightly uneven, somewhat colliculose, subpubescent to glabrous in places, brick red to brown

or blackish at margin, occasionally subzonate; margin thin, incurved, substerile, somewhat repand; stem slender, subcentral to excentric or lateral, inclined, somewhat spongy bulbous at base, brick red, pubescent, solid, 1–2 cm. long, 3–4 mm. wide; substance fibrous, tough-felty, brick red in upper part of pileus, more compact and darker below; teeth slender, terete, dark reddish-umber to blackish, decurrent, 2 mm. or less long, 0.15–0.20 mm. wide, about 3 to one millimeter; spores subglobose, tuberculate, 3.5–4 $\mu$ wide.

HAB.: On earth in woods. Aug.

RANGE: South Carolina, *Ravenel;* Georgia, *Underwood.*

EXSICC.: Ravenel, Fung. Car. Exsicc. **3**: 17, as *Hydnum ferrugineum* Fries.

The type specimen is in the Underwood Herbarium, No 411, from Tallulah Falls, Ga. A part of the same collection is also in the herbarium of the New York Botanical Garden with the same number. The Ravenel specimens were distributed in his exsiccati as *Hydnum ferrugineum* Fries, but the plants are very distinct from that species in nearly every feature. The species is distinctly marked by its peculiar brick red color and its more or less dimidiate pileus. I take pleasure in dedicating this species to Professor Earle, whose excellent field notes have frequently aided in the discrimination of species in this family.

### 12. **Hydnellum humidum** (Banker)

*Hydnum humidum* Banker; White, Bull. Torrey Club, **29**: 553 1902.

Plants terrestrial, mesopodous, rather large; pileus irregular, lobed, and convolute, depressed, scrobiculate, often cracked more or less radiately, 5–8 cm. wide; surface minutely pubescent, yellowish, becoming light yellowish brown; margin obtuse sterile; substance spongy to corky, exuding water when pressed, becoming hard, compact, brittle when dried, faintly zonate, grayish to yellowish brown; stem short, deformed, brownish, stout, 1–4 cm. long, 1–1.5 cm. wide; teeth slender, terete, acute, dark brown with light tips, decurrent, distributed irregularly 3–6 to one millimeter, 5 mm. or less long, 0.1–0.2 mm. wide; spores subglobose to ovoid, irregular, tuberculate, brownish, 3.7–4.5 $\mu$ by 4.5–5.5 $\mu$; taste mild; odor strong, but not unpleasant.

HAB.: On ground in damp woods. Sept.–Oct.

RANGE: Maine, *White;* New Jersey, *Ellis.*

The type specimen was collected in Maine and is now in the herbarium of the New York Botanical Garden but is badly injured by mould. The New Jersey specimens also in the New York Botanical Garden appear to be identical in every respect and are in good condition. The original description is here supplemented by a study of these. The plants were referred by M. C. Cooke to *Hydnum compactum* Fries but I cannot see that they have any relation to that species, and certainly they do not in the least resemble European specimens referred to *H. compactum*. The field notes on the type specimen state that the teeth were 5 mm. long, but in all the dried specimens they are notably short, not over 2 mm. long.

13. HYDNELLUM SUAVEOLENS (Scop.) Karst. Medd. Soc. Faun. et Fl. Fenn. 5 : 27. 1879

*Hydnum suaveolens* Scopoli, Fl. Carn. 2 : 472. 1772.

*Hydnum boreale* Banker; White, Bull. Torrey Club, 29 : 553. 1902.

*Calodon suaveolens* Karsten, Rev. Myc. 3[1] : 20. 1881.

Plant terrestrial, mesopodous, solitary, large; pileus obconical convex to plane, depressed at center, somewhat round, 7–15 cm. wide; surface woolly pubescent subeven to uneven, white becoming dirty greenish; margin thick, obtuse; substance spongy, soft, whitish in the upper part of the pileus, hard, compact in the lower portion, zonate with whitish and deep lavender or bluish bands; stem short, almost wanting, compressed; teeth short, terete, obtuse, or acute, decurrent, brownish with white tips, 5 mm. long, 0.5 mm. wide; mycelium purple, persistent; odor unpleasant.

HAB.: On ground in leaf mould under balsam.

RANGE: Canada, *Saunders;* Maine, *White, Churchill.*

ICON.: Harzer, Naturg. Abb. Pilze, *pl. 52;* Quélet, Les Champ. du Jura et des Vosg., *pl. 20. f. 1.*

EXSICC.: Linhart, Fung. Hung. 346; De Thümen, Fung. Aust. 919.

The plant described as *Hydnum boreale* Banker, *loc. cit.*, is probably an unusually large and abnormal form of *H. suaveolens* and I have therefore reduced it to synonymy. The Churchill and Saunders specimens which are in the state herbarium at Albany are apparently typical plants and conform in all respects to the specimens

of the European exsiccati. The icones cited represent our plant fairly well except that they all show too intense a blue color, but the color may have faded greatly in drying. It has not been my fortune to see the living plant. I have not been able to secure entirely satisfactory spore characters from the American specimens. Apparently the spores are pale in color, oblong, angular, and somewhat tuberculate. The plant appears to be distinctly northern in its distribution.

### 14. **Hydnellum cyaneotinctum** (Peck)

*Hydnum cyaneotinctum* Peck, Bull. Torrey Club, **30** : 98. 1903.

Plant terrestrial, mesopodous, light colored, medium size; pileus obconic, depressed to convex, somewhat round to irregular, 3–9 cm. wide, 2–10 mm. thick; surface subeven to uneven, sometimes somewhat colliculose, woolly pubescent to subfloccose, drab to isabelline becoming bluish toward the margin, fading to pale-blue or disappearing in drying, azonate; margin thick, rounded, sterile, becoming brown to black where rubbed; substance spongy tomentose in upper part of pileus, compact, hard, and woody below and in stem, more or less transversely zonate, often tinged with blue; stem usually central, sometimes lateral, vertical, subterete, attenuate downward, but surrounded below by a bulbous mass of spongy tomentum that reaches nearly to the pileus and makes the stem appear deformed outwardly, surface brownish, about 1 cm. long by 7–10 mm. wide, bulbous base about 1.5 cm. wide; teeth slender, terete, acute, shortening uniformly toward stem and margin, umber at base becoming lighter toward tip, 4–0 mm. long, 0.25 mm. wide near base to 0.09 mm. wide at tip, decurrent to bulbous base; spores oblong, coarsely tuberculate, often uniguttulate, "purplish brown in spore print," about 4 by 7 $\mu$ wide; basidia clavate, four-spored, sterigmata about 3.5 $\mu$ long; odor farinaceous, not strong.

HAB.: On ground under Hemlock. July–Sept.

RANGE: Maine, *Anderson;* New York, *Peck.*

The plant resembles in structure and consistency *H. velutinum* and *H. suaveolens*, differing from the former chiefly in color, and from the latter both in color and odor.

The type specimens were from Orris Island, Me. The New York specimens were found by Peck himself in Warren County, and sent to the writer. They correspond in all respects to the

original description, except I observe the spores to be distinctly oblong, whereas Dr. Peck says "globose 4 $\mu$ wide."

### 7. PHELLODON Karst. Rev. Myc. 3[1]: 19. 1881

Plants chiefly terrestrial, mesopodous, often deformed, usually light colored, whitish, grayish or buff, sometimes dark; substance fibrous, tough, often thin, fragile when dry, sometimes in two layers, the outer felty, soft, the inner hard, compact; spores white or hyaline, usually echinulate.

The genus as here defined is closely related to *Hydnellum* and perhaps all the forms should be included in the one genus as was at first intended in this paper, but the spore characters are so distinct and constant that it seems desirable to recognize these species as constituting a closely related genus.

Under low powers of the microscope the spores frequently appear to be smooth but with high powers I have always found them roughened with exceedingly fine points. In *Hydnellum* the roughening of the spores is coarse enough to be detected with low powers of the microscope and appears as rounded protuberances often so large as to cause the spore to appear irregular in outline. While high powers of the microscope are often necessary to determine the character of the roughening and sometimes even that the spores are rough in this genus, the tough substance combined with the white spores is usually sufficient to separate it from others closely allied.

#### Synopsis of the Species

Substance of pileus in two distinct layers, the upper soft felty, and the lower more compact, darker; plants usually with odor.

Compact part of substance and core of stem blackish.

Surface of pileus floccose-tomentose, subzonate, depressed. 1. *P. niger.*

Surface of pileus pubescent to villose, azonate, convex, rarely depressed. 2. *P. alboniger.*

Compact part of substance and core of stem, grayish or light colored.

Surface of pileus brown to blackish brown, with a white margin; odor strong when fresh, milder when dry. 5. *P. putidus.*

Surface of pileus grayish fuscous to smoky, rarely ochraceous; odor developed in drying.

Pileus-woolly-pubescent, irregular, subsessile, forming crust-like masses. 3. *P. vellereus.*

Pileus subpubescent to glabrous, subregular; stem slender. 4. *P. graveolens.*

Substance of pileus nearly uniform, thin.
Surface of pileus more or less zonate.
Zonations alternately light and dark, raised. 6. *P. fasciatus.*
Zonations shading regularly to the margin.
Plants more than 1 cm. wide, color reddish brown or chestnut.
Plants 1–3 cm. wide, confluent, odorless.
7. *P. tomentosus.*
Plants more than 3 cm. wide, rarely confluent, fragrant.
8. *P. coriaceo-membranaceus.*
Plants small, less than 1.5 cm. wide, coloray-brown or mouse-colored.
9.gr. *P. Ellisianus*
Surface of pileus azonate; substance soft, cottony. 10. *P. delicatus.*

1. PHELLODON NIGER (Fries) Karst. Rev. Myc. 3[1]: 19. 1881

*Hydnum nigrum* Fries, Obs. Myc. 1: 134. 1815.

*Hydnellum nigrum* Karsten, Medd. Soc. Faun. et Fl. Fenn. 5: 27. 1879.

*Calodon niger* Quélet, Ench. Fung. 191. 1886.

Plant terrestrial, mesopodous, medium size; pileus expanded, depressed, subround to irregular, uneven, 2–5 cm. wide; surface floccose-tomentose toward center, radiate-fibrose toward margin, subzonate, blackish to olivaceous when fresh, mouse-gray to fuscous when dry; margin thin, acute, sterile; substance spongy or pithy, fuscous in upper part of pileus, compact, hard, bluish black in lower part and continuous as a core in the stem; stem slender, deformed, surrounded below by spongy tomentum, surface floccose-tomentose, fuscous 6 cm. long, 1.5 cm. wide; teeth slender, terete, or flattened and coalescent toward the margin, often forming concentric lamellae, subpuberulent, scarcely decurrent, whitish, at length cinereous; spores globose, echinulate, white, 4–5 $\mu$ wide; taste mild, odor faint in the dried plant.

HAB.: On ground among leaves. Aug.

RANGE: Connecticut, *Underwood, Earle;* New York, *Peck.*

ICON.: Fries, Icon. Select. Hym. 1: *pl. 5. f. 2.*

EXSICC.: Karsten, Finland Fung. 908; Sydow, Myc. March, 3334; Allescher & Schnabl, Fung. Bavar. 132; Roumeguere, Fung. Select. Exsicc. 4309.

These plants differ from Fries' description in that they have a faint odor when dried, are subzonate, not of one color within, and Fries does not mention two kinds of substance to the pileus. His figure in the *Icones*, however, represents a plant subzonate and is a good representation of our plant in all particulars except that

the stem is too stout. The European exsiccati also contain typical examples of the American plant, except that Roumeguere 4309 appears to be more delicate than our plant.

### 2. **Phellodon alboniger** (Peck)

*Hydnum albonigrum* Peck, Rept. N. Y. State Mus. Nat. Hist. **50**: 110. 1897.

Plant terrestrial, mesopodous, gregarious, confluent, small size; pileus obconical, subconvex, expanded, or slightly depressed subround to irregular, somewhat uneven, 1–7 cm. wide; surface covered with a whitish pubescence, sometimes subglabrous, cinereous to fuscous or mouse-colored, blackish where handled, azonate; margin thin, obtuse, sterile; substance spongy tomentose in upper part of pileus, compact, hard when dry, fibrous, bluish-black in lower part and continuous as a core to the stem, very hygrophanous so the water can be squeezed out in drops, juice clear watery; stem short, slender or stout, surrounded below by a large mass of spongy tomentum often as large or larger than the pileus, solid hard and black within, surface fuscous or mouse-colored, pubescent, 1–2 cm. long, 0.5–1 cm. wide; teeth slender, terete, decurrent, whitish or cinereous, becoming black where injured, 2 mm. or less long, longest toward stem; spores subglobose, echinulate, white, 3.5–4 $\mu$ wide; odor of fresh plant not noticeable, becoming strong in drying.

HAB.: Growing in wet ground in woods. July–Aug.

RANGE: (A) Maine, *White;* Massachusetts, *Vail;* Connecticut, *Underwood;* New York, *Peck, Banker, Earle;* Pennsylvania, *Schweinitz;* Tennessee, *Murrill.*

(B) Connecticut, *Underwood:* New York, *Underwood;* New Jersey, *Ellis;* Delaware, *Commons;* Kentucky, *Morgan.*

EXSICC.: Ellis, North. Am. Fung. 710, as *Hydnum graveolens.* The type specimen is in the N. Y. State Herbarium at Albany. The species is closely related to *P. niger* (Fries) Karst but differs in its lighter superficial color, its whitish tomentum, the less depressed pileus, the surface of the pileus not shaggy floccose but only pubescent or tomentose, and in the larger mass of tomentum about the base. In old specimens the spongy tomentum of the cap seems to break up and fall away exposing the hard dark underlayer which often appears when thus exposed zonate, the adhering pieces of the old tomentum giving the surface a scrobic-

ulate character. Such is the appearance of the plant in the Schweinitz Herbarium which he referred to *H. compactum* Pers. A collection from West Park, N. Y., shows plants faintly zonate and with some of the teeth flattened and coalescent forming pseudopores, perhaps a form approaching *P. niger*.

The collections quoted under (B) above show plants of fairly constant characters differing from the typical specimens of the first list in a somewhat taller habit of growth, the hard interior not quite so dark, and the pileus buff or isabelline. Whether these represent a distinct species or variety is, however, doubtful, and can be decided only by more complete field study. Possibly they represent older states of the plant. The specimen examined in Ellis, N. Am. Fung. 710 issued as *Hydnum graveolens* Fries was of this type but does not appear to me to answer at all to Fries' description or figure. Most of the plants of this latter type have been referred to *H. suaveolens* Scop. but this disposition of them seems to be as unsatisfactory as the former and in both cases the odor appears to be the determining factor of the diagnosis.

The odor is very marked when the plants are drying and persists for a long time afterward, but does not seem to be so permanent as in *P. vellereus*. It is described by several authors as the odor of melilot, but to me it is more like that of bone-meal.

### 3. **Phellodon vellereus** (Peck)

*Hydnum vellereum* Peck, Rept. N. Y. State Mus. Nat. Hist. 50: 110. 1897.

Plant terrestrial, mesopodous or submesopodous, confluent, often forming crust-like masses among the dead leaves, cream-colored to ash-gray, sometimes brownish; pileus expanded, subobconic, irregular, lobed, depressed, often confluent, 2.5–10 cm. wide; surface woolly-pubescent or densely subtomentose, very uneven or colliculose, grayish white or brownish with the pubescence whitish, sometimes the whole cream-colored, lighter at margin, azonate; margin thick, obtuse, sterile, whitish or cream-colored; substance fibrous, tough, rather soft above, more compact below and in the center of the stem, grayish above to light brown in the compact portion, subzonate, dry; stem short, deformed, often surrounded below by an irregular mass of spongy tomentum concolorous with the pileus, 1.5–2 cm. long, 0.5–1.5 cm. wide; teeth short, slender, terete, acute, shortening to the sterile margin, decurrent, whitish

to ash-gray, lighter at the tips, 1.5 mm. or less long, 0.3 mm. wide at the base; spores subglobose, echinulate, white, about 3.5 $\mu$ wide; taste mild, odor in drying very fragrant, resembling slippery elm, and persistent in the dried plants for years.

HAB.: Among fallen leaves in mixed woods. Aug.

RANGE: Connecticut, *Earle 1080, White, Underwood;* New York, *Peck, Banker.*

The type plant is in the N. Y. State Herbarium at Albany. The species is near *P. graveolens* (Delast.), from which it may be distinguished by its subsessile habit and its thickened woolly pubescent pileus. From *P. alboniger* (Peck), some forms of which it also resembles, it may be distinguished by its brownish not blackish substance, and by its dry not hygrophanous character.

### 4. **Phellodon graveolens** (Delast.)

*Hydnum graveolens* Delastre; Fries, Epic. 509. 1836–38.

Plant terrestrial, mesopodous, gregarious, medium size; pileus thin, expanded, depressed, nearly round, 2–6 cm. wide; surface somewhat uneven, subcolliculose at center, subpubescent to glabrous, azonate, smoky with fuscous blotches toward center, creamy-white at margin, margin incurved, sterile, subrepand; substance soft spongy at top of pileus, more compact below and in the center of stem, smoky; stem short, subcentral, somewhat deformed, not bulbous, fuscous, pubescent, 2 cm. long, 0.8 cm. wide; teeth short, creamy-white to ash-gray, subdecurrent, less than 1 mm. long; spores subglobose, echinulate, white, 3.5 $\mu$ wide; odor fragrant.

HAB.: On ground in woods. Sept.

RANGE: Connecticut, *Underwood;* New York, *Van Hook, Shear;* New Jersey, *Ellis.*

ICON.: Fries, Icon. Select. Hym. *pl. 6. f. 1.*

This species has given me more trouble than any other in the family. The above description is drawn up from dried plants which appear to have the essential characters of Delastre's plant and conform best to Fries' figure. These forms are of constant and uniform character as shown in the above distribution, but in the collections they are more or less mixed up with other very different appearing plants. It is surprising to see the great variety in the forms that have been referred to this species. Apparently everything with a strong odor has been referred to *Hydnum graveolens* Delast., a practice which seems to have had its origin in Cooke's

determinations, if we may judge by the following comments made by him on a specimen much resembling *H. Carbunculus* (Secr.). "This is undoubtedly the American representative of our European *Hydnum graveolens* Delast. and we have but one species of that name. It has the same odor. The only strong scented one besides is *H. suaveolens* which is blue internally. I agree with you it is not like Fries' figure nor like our specimens," etc.

While under this name in the collections there are many very distinct forms which doubtless represent well-marked species they are in such confusion that it is impossible to separate them satisfactorily. Determinations by Bresadola, Patouillard, and others do not agree even with respect to the same plants. Careful discriminating field work on these forms will I am confident result in the separation of several distinct species. It is important as a basis of this work, however, that *P. graveolens* (Delast.) should be clearly defined.

### 5. **Phellodon putidus** (Atkin.)

*Hydnum putidum* Atkinson, Mushr. Edib., Pois., etc., 199. 1900.

Plant terrestrial, mesopodous, irregular, large, brown with broad white margin; pileus broad, depressed or subinfundibuliform, irregular, lobed, 8–12 cm. wide; surface uneven, at first subtomentose or pubescent becoming smooth, subzonate, brown to blackish-brown toward center, white to cream-colored toward margin; margin thick, obtuse, sterile; substance spongy whitish in upper part of pileus, tough, more compact but not very hard, darker in lower part, whole plant light and pithy when dry, pliant when moist; stem stout, irregular or deformed, surrounded by a thick spongy tomentum; teeth long, slender, terete, acute decurrent, at first white or cream-colored changing, through salmon or directly, to grayish-brown, 4 mm. or less long; spores globose, echinulate, white, 3–4 $\mu$ wide; odor fetid when fresh disappearing in drying.

HAB.: On ground in woods. Aug.–Sept.

RANGE: North Carolina, *Atkinson*.

ICON.: Atkinson, *loc. cit.* 1st. ed. *pl. 69*; *Idem*, 2d. ed. *pl. 79*.

The type plants collected at Blowing Rock, N. C., are in Cornell University Herbarium No. 4334. These are the only specimens I have seen of this species, which is well marked and clearly defined. The above description is drawn up largely from Atkin-

son's original account supplemented by a reëxamination of the type which was generously loaned me for the purpose. Professor Atkinson describes the odor when fresh as that "of a perspiring darkey."

### 6. **Phellodon fasciatus** (Peck)

*Hydnum fasciatum* Peck, Rept. N. Y. State Mus. Nat. Hist. **41**: 78. 1888.

Plants terrestrial, mesopodous, gregarious, sometimes confluent, small, zonate; pileus thin, spreading nearly plane, umbilicate, almost round, 1.5–3 cm. wide; surface "blackish brown with several narrow, elevated, scabrous, tawny-gray, concentric zones"; substance fibrous, tough, thin; stem short, slender, tough, tawny gray or blackish, 1–1.5 cm. long, 2–3 mm. wide; teeth short, decurrent, ferruginous-brown; spores subglobose, tuberculate, about 4 $\mu$ wide.

HAB.: On ground in woods. Sept.

RANGE: New York, *Peck.*

The type specimens are in the New York State Herbarium at Albany. The original collection made in the Catskills is the only one known, although the plants are clearly marked and not inconspicuous. It would appear to be a rare species. The species is evidently closely related to *P. tomentosus* (L.) but is clearly distinguished from that species by its peculiar sharply defined zonations and its darker color.

### 7. **Phellodon tomentosus** (L.)

*Hydnum tomentosum* L. Sp. Pl. **2**: 1178. 1753. Not *H. tomentosum* Schrader, Spic. Fl. Germ. 177. 1794.

*Hydnum cyathiforme* Schaeffer, Fung. Bav. et Pal. **4**: 93. 1763. Not *H. cyathiforme* Bulliard, Hist. des Champ. de la France, 308. 1791.

*Hydnellum cyathiforme* Karsten, Medd. Soc. Faun. et Fl. Fenn. **5**: 27. 1879.

*Phellodon cyathiformis* Karsten, Rev. Myc. $3^1$: 19. 1881.

*Calodon cyathiformis* Quélet, Ench. Fung. 191. 1886.

Plant terrestrial, mesopodous, gregarious, confluent, small, zonate; pileus plane to depressed, occasionally subinfundibuliform, nearly round, 1–2 cm. wide, often confluent into crust-like layers, sometimes several decimeters wide; surface radiately fibrous-striate,

floccose-tomentose or subscrobiculate at the center of the disk, subsulcate-zonate, castaneous or darker near center to light cream-color or whitish at margin; margin thin, substerile; substance fibrous tough, thin; stem slender, terete, attenuate downward to a common floccose-tomentose base imbedded in the substratum, subpubescent, cream-colored above to glabrous dark reddish brown below, 1–1.5 cm. long, 2–7 mm. wide; teeth slender terete, acute, scarcely decurrent, whitish to cream-colored, 2 mm. long and less; spores subglobose, echinulate, white or hyaline, 3.5–4 $\mu$ wide.

HAB.: On ground among moss. Aug.–Nov.

RANGE: Maine, *MacDougal;* New Hampshire, *Minns;* Connecticut, *Underwood;* New Jersey, *Ellis.*

ICON.: Schaeffer, *op. cit., pl. 139;* Harzer, Naturg. Abb. Pilze, *pl. 3. f. 1–5.*

EXSICC.: Krieger, Fung. Sax., 906; Roumeguere, Fung. Gall., 2306; Sydow, Myc. March., 206 and 1011; DeThumen, Myc. Univ., 207; Rabenhorst, Fung. Eur., 611 and 2304; Herpell, Samml. präp. Hutp., 115; Ellis, N. Am. Fung., 927.

The species resembles in many respects *Hydnellum zonatum* (Batsch) but is clearly distinct in color and especially widely separated by its spore characters.

There has been some doubt among mycologists as to the identity of *H. tomentosum* L. In fact from the two-line description in the *Species Plantarum* it is not possible to decide what species the name represents, but in Fl. Suec. 383, the description seems clearly to indicate the above plant.

### 8. **Phellodon coriaceo-membranaceus** (Schw.)

*Hydnum coriaceo-membranaceum* Schweinitz, Syn. N. Am. Fung. 162. 1834.

*Hydnum graveolens subzonatum* Peck, Bull. N. Y. State Mus. Nat. Hist. **75**: 24. 1904.

Plant terrestrial, mesopodous, gregarious, more or less confluent, medium size, zonate; pileus subplane, depressed or occasionally in small forms infundibuliform, nearly round or somewhat irregular, 3–5 cm. wide; surface radiately striate, subsulcate-zonate, dark brown at center growing lighter by zones to cream-colored margin; margin thin, sterile, more or less lacerated; substance fibrous, tough, brittle when dry, thin, 1–2 mm. thick; stem slender, terete, attenuate downward, dark brown to nearly black at base,

becoming lighter upward, rugose, central, 2–3 cm. long, 3–5 mm. wide; teeth slender terete, tapering, acute, flexuose, cream-colored, 1.5–2 mm. long becoming shorter to the sterile margin, not decurrent; spores subglobose, echinulate, white, 3.5 $\mu$ wide; odor strong, heavy, resembling that of *P. alboniger* (Peck) and very persistent in the dried plant.

HAB.: On ground among moss. Sept.

RANGE: New Brunswick, *Bertolet*; New York, *Peck*.

This species is almost an exact duplicate of *P. tomentosus* (L.) as recognized in this paper in most of its characters and perhaps should be regarded only as a variety of that species. Its larger size and especially its pronounced odor seem to warrant its recognition as a distinct species. I have never detected any odor in the smaller plant while the plants referred here retain the strong odor even after many months.

The type specimen in the Schweinitz Herbarium is wholly destroyed and the above determination is based entirely on his description, with which these plants appear to answer in every particular. Schweinitz does not make mention of an odor. This omission can not be regarded as too important since tastes and odors were often unnoticed by the older mycologists. The size which he attributes to his plants would seem to preclude their being *P. tomentosus* (L.). It is very doubtful, however, if he would have made any distinction between the two species. As his description applies so well to the plants here under discussion and as it can not be shown that it pertains to any other forms I feel justified in retaining Schweinitz's name for the above species.

### 9. **Phellodon delicatus** (Schw.)

*Hydnum delicatum* Schweinitz, Syn. N. Am. Fung. 161. 1834.

Not *H. delicatum* Klotsch. Ann. Nat. Hist. **3**: 395. 1839.

Plant terrestrial, mesopodous, gregarious, sometimes confluent, small; pileus nearly round to flabelliform, expanded, depressed to subinfundibuliform, 1–2 cm. wide; surface even, pubescent, azonate, grayish-white to light brown; margin paler, sterile; substance thin, soft, cottony throughout, hymenial surface arachnoid, concolorous; stem very slender, subcentral to lateral, attenuate downward to an abrupt bulbous base, solid, 1 cm. long, about 1 mm. wide; teeth short, stout, subconical, subdecurrent, cream-colored to cinereous, 1.5 mm. long and less; spores globose, hyaline, echinulate, 3–3.5 $\mu$ wide.

HAB.: On ground under logs. Oct.–Nov.

RANGE: New Jersey, *Ellis;* Pennsylvania, *Schweinitz.*

The type specimen is in the Schweinitz Herbarium in the Philadelphia Academy of Science, and though somewhat fragmentary shows many characters of the plant. The only essential difference between the Schweinitz and Ellis plants is in the color. The former is nearly a tan color and the latter is grayish brown, but Schweinitz in his description says "cinereo gilvo."

The above description is drawn from the dried specimens, as it has not been my privilege to see the living plants or to receive any field notes upon the species. It is a very delicate little species and appropriately named. I know of nothing with which it appears to be very closely related.

### 10. **Phellodon Ellisianus** sp. nov.

Plant terrestrial, mesopodous, gregarious, slightly confluent, small; pileus nearly round, umbilicate to infundibuliform, 0.7–1.5 cm. wide; surface even, radiately fibrous-striate, subzonate, nearly smooth, mouse-colored to fuscous with whitish marginal band; margin thin, even, sterile, whitish; substance fibrous, subcompact, thin; stem slender, terete, central, attenuate downward to a bulbous tomentose base, cinereous above to mouse-colored below, 4–7 mm. long, 1–2 mm. wide; teeth relatively coarse, short, subdecurrent, cinereous, 1 mm. long and less, 0.12 mm. wide, 3 and 4 to one millimeter; spores globose, echinulate, white, 3.5 $\mu$ wide.

HAB.: On the ground in wood-road. Oct.

RANGE: New Jersey, *Ellis.*

The type specimens are in the Herbarium of the New York Botanical Garden. The species in some of its characters comes near *P. delicatus* (Schw.) but differs in color, its more compact and firmer texture of the substance, its more regular form of pileus, and its deep central depression. In size also it averages somewhat smaller. It is a most beautiful and delicate little species, likely to be overlooked on account of its size and color. The only specimens known are those collected by J. B. Ellis to whom I take pleasure in dedicating this species.

SPECIES DUBIA ET INQUIRENDA.

*Hydnum confluens* Peck, Rep. N. Y. State Mus. Nat. Hist. 26: 71. 1874. The type specimen in the N. Y. State Herbarium at

Albany resembles very much the forms here referred to *P. niger*, but is distinctly marked by a peculiar ring of spongy tomentum about the stem a little below the cap. This feature, however, is so unusual that I am inclined to regard it as a freak until other plants are found showing it to be a true specific character.

### 8. **LEAIA** gen. nov.

Plants pileate or resupinate, epixylous, dark to light umber or grayish, subiculum of branched processes clothed above with a dense shaggy coat of coarse tomentum; teeth slender, terete, acute; spores minutely papillose, elliptical, guttulate, hyaline or white.

This genus is unique among the Hydnaceae. It is difficult to say where it is most nearly related, for it does not appear to have any very near relation to any other genus of the family. It has some characters of *Hydnellum* and in some respects suggests connection with *Auriscalpium*. The spore characters especially suggest the latter relationship. The branched processes, which are its most fundamental peculiarity, are suggestive at first thought of *Hericium* but the dark color, tough fibrous substance, and papillose spores at once separate it from that genus. The character of the branched processes also is entirely different and though difficult to describe, are readily recognized when once seen. This branching of the plant body also readily separates the genus from either *Hydnellum* or *Auriscalpium*.

It seems most appropriate that this well-marked genus should be dedicated to the memory of that pioneer mycologist of the Ohio Valley, Mr. T. G. Lea, who first detected one of its species.

**Synopsis of the Species**

| | |
|---|---|
| Plant pileate, dimidiate; ends of branches flattened. | 1. *L. piperata*. |
| Plant wholly resupinate; ends of branches subterete. | 2. *L. stratosa*. |

### 1. **Leaia piperata** sp. nov.

Plant sessile, subdimidiate to flabelliform, caespitose, subimbricate, laterally confluent to 8 or 10 cm. wide; the pilei ascending toward the margin, 0.5–4 cm. wide, 1–3 cm. long, less than 0.5 cm. thick excluding the teeth; the body of the plant composed of repeatedly branching but not anastomosing processes, tough, fibrous, flexible, umber, clothed above with a dense tomentum of brownish strigose hairs, the lower branches horizontal, with the

teeth pendent from their lower sides, ending at the margin in vertically-compressed naked free ends which are paler and subtranslucent, the upper branches ascending and terminating on the surface of the pileus in terete free ends wholly surrounded with strigose branched hairs but with the tip naked, paler, subtranslucent, the projecting ends standing up like miniature spruce trees, the naked ends becoming blackish in old weathered specimens and in drying; margin fimbriate from the projecting ends of the branches; teeth slender, terete, acute, shortening toward the margin, 3 mm. long and less, 0.14–0.18 mm. wide, 2 or 3 to one millimeter, dark umber to pale brown toward the margin, in composition and color like the branched processes; spores ovoid or elliptical, hyaline, with one or more irregular guttulae, minutely papillose, 3.5–4 $\mu$ by 4.5–5 $\mu$; sterigmata 3–3.5 $\mu$ long; basidia four spored, clavate; taste intensely acrid; odor not marked.

HAB.: On very rotten stump in damp woods. June–Aug.

RANGE: New York, *Ellis, Banker;* Nebraska, *Webber;* Iowa, *Holway.*

The type material is in the author's collection preserved both dry and in formalin, the latter method seeming to preserve all the characters of the plant perfectly. Material obtained a year later from the same stump is in the New York State Herbarium at Albany. This species is the type of the genus.

The plant was first found by Ellis in Potsdam, N. Y., in 1855 and was sent for determination to Ravenel, whose reply was "new and very curious." No attempt, apparently, was made to describe or publish the species and it was soon buried in the mass of the Ellis collections. In the spring of 1904 the writer noticed the specimen, small and somewhat the worse for age, in the collection at New York and took notes on it. That very summer it was his fortune to find a considerable quantity of the same thing on a stump in Schaghticoke, N. Y., and it was from this material that the above description has been prepared.

The Webber and Holway specimens differ from the type plants in the pileus being plane with the surface nearly even. Apparently the ends of the branches do not project and form a roughened surface as in the type forms. It is doubtful, however, if they represent a fixed variation. These plants were referred by Ellis first to *Hydnum cirrhatum* Pers. and afterwards to *Hydnum strigosum* Swartz, but the character of the subiculum shows them to be distinct from either.

### 2. **Leaia stratosa** (Berk.)

*Hydnum stratosum* Berkeley, Lond. Jour. Bot. 4: 307. 1845.

Plant wholly resupinate on the under side of logs, frequently stratose from successive growths, spreading 2–10 cm.; subiculum thin, 1–2 mm., consisting of fine repeatedly branched processes not anastomosing, with free subterete ends at the margin, clothed above, that is, between the branches and the substratum, with a varying thickness of a woolly umber tomentum; substance of the subiculum tough, fibrous, brownish; margin irregular, lobed, fimbriate from the projecting ends of the branches, subfertile; teeth slender, terete, tapering, acute, subflexuose, pendent from the branches concolorous and similar in substance, at length hoary from the spores, 1–2.5 mm. long, 0.2–0.3 mm. wide; spores globose to subovoid, white or hyaline, one or more guttulate, minutely papillose, 4–7 $\mu$ wide.

HAB.: On rotting logs. April–Sept.

RANGE: New York, *Underwood;* Indiana, *Underwood;* Ohio, *Lea.*

The type plant collected by T. G. Lea in Ohio is in the Kew Herbarium, England. Through the kindness of Dr. L. M. Underwood comparison of our plants with the type was effected, and there can be no doubt as to their identity. The above description is drawn up from the dried specimens. We have not seen the fresh plant and the taste is not known.

The plant is remarkable not only for its unique character, but also for the fact that in a period of over fifty years only one collector besides its discoverer has ever found it, although it would seem to have considerable range of distribution. So keen an observer and diligent a collector in the type region as A. P. Morgan became very sceptical concerning it, remarking: "There is no record of its ever having been found again, and Mr. Berkeley does not enumerate it in the notices of North American Fungi. I have never met with anything that would answer to it in any way." * It is evident that the plant is rare, as is also its congener, here published for the first time.

### 9. AURISCALPIUM S. F. Gray, Nat. Arr. Brit. Pl. 1: 650. 1821

Plant pileate, pleuropodous, hirsute; pileus with a sinus through which the slender cylindrical stem passes; substance tough, flexi-

* Jour. Cin. Soc. Nat. Hist. 10: 9.

ble; teeth slender, terete, tapering; spores ovoid, white, more or less guttulate, minutely papillose.

The genus is monotypic. In color, consistency and spore characters it shows considerable affinity with *Leaia*, but shows no indication whatever of the branching peculiar to that genus.

1. AURISCALPIUM AURISCALPIUM (L.) S. F. Gray, Nat. Arr. Brit. Pl. **1**: 650. 1821

*Hydnum Auriscalpium* L. Sp. Pl. **2**: 1178. 1753.

*Auriscalpium vulgare* Karsten, Medd. Soc. Faun. et Fl. Fenn. **5**: 27. 1879.

*Pleurodon Auriscalpium* Karsten, Rev. Myc. **3**[1]: 20. 1881.

*Leptodon Auriscalpium* Quélet, Ench. Fung. 192. 1886.

Plants small, pleuropodous, dark brown, 1–6 cm. high; pileus, horizontal, subcordate to reniform, convex to subplane, 0.5–2.5 cm. wide; surface hirsute or subglabrous in age, brown to blackish; margin strigose, hairy, fimbriate, fertile; stem vertical, slender, terete, solid, bulbous at base, attenuate upward and passing through the sinus of the pileus bends over adnate to the upper surface as a ridge to near the center, hirsute-tomentose, spongy at base, dark brown, darker than pileus, 1–6 cm. long, 1–3 mm. wide; substance tough, flexible, light brown; teeth slender, terete, tapering, acute, light brown to grayish-white from the spores, 0.5–2 mm. long, 0.10–0.15 mm. wide, not decurrent; spores ovoid to subglobose, minutely papillose, often guttulate, white or hyaline, 4.5 by 5–6 μ.

HAB.: On decaying cones of conifers. June–Nov.

RANGE: Maine, *Ricker;* Massachusetts, *Clark;* Minnesota, *Holway:* Iowa, *Macbride;* Arizona, *Griffiths & Thornber;* Oregon, *Sweetser.*

EXSICC.: M. C. Cooke, Fung. Brit., 306; Desmazières, Pl. Crypt de Fr., 954; De Thumen, Myc. Univ., 1106; Rabenhorst, Fung. Europ., 17; Roumeguère, Fung. Select., 6935; Ellis & Everhart, Fung. Columb. Cont. by C. L. Shear, 1408; Cavara, Fung. Longob., 106; Mougeot & Nestler, Stirp. Crypt. Vog. Rhen., 777; Ellis & Everhart, N. Am. Fung. 2d. Ser., 2511.

The species is also European and through all its widespread distribution maintains a remarkable constancy of character and is one of the most readily recognized species in the family.

In one set of Desmazieres Pl. Crypt. de France 954 the specimens showed normal plants apparently growing from the stipe of an-

other plant, as though the plant might be sometimes proliferous on itself. In the fall of 1901 I received from Prof. Sweetser, Forest Grove, Oregon, some fresh plants of *A. Auriscalpium* packed in damp moss and enclosed in a tight can. A few days after they were received what appeared to be new growths were observed starting out from the base of the stipe. In several cases they were observed later to start from the upper part of the stipe also and even from the pileus. The material was placed in a damp chamber where the growth was maintained from Dec. 7 to Jan. 25. During this time a number of the growths developed, becoming slender subterete stipe-like bodies, more or less hirsute, with conical-pointed naked tips, 1–5 cm. long and 1–4 mm. wide, brownish toward the base, becoming pale toward the naked tips, covered with strigose hyaline hairs. About the naked tips and especially near the edge of the growth of hairs a few basidia were observed with four spores about 4–5 $\mu$ wide. In time these growths which were all nearly vertical gave off branches similar to themselves, and finally on these stems, especially in the region of the naked tips, small conical papillae were formed. At the time it was thought that these growths would develop into normal plants of *A. Auriscalpium* but pilei never developed. Considering the resemblance of these growths in consistency and color to the *A. Auriscalpium* plants their association and the evidence of proliferation given by the Desmazieres specimens it seems probable that these were abnormal growths of the plant.

### 10. **GRANDINIOIDES** gen. nov.

Plant pileate, thin, membranaceous or subgelatinous; teeth minute, papilliform or subcylindrical, subciliate.

This genus differs from all the preceding in its subgelatinous or membranaceous substance and its exceedingly minute almost microscopic teeth. The latter feature suggests its relation to *Grandinia* as indicated by the name, but it differs from the latter in its consistency, its pileate form, and the teeth being more minute.

### 1. **Grandinioides flavum** (Swartz)

*Peziza flava* Swartz, Nov. Gen. et Sp. Pl. 150. 1788.

*Hydnum flavum* Berkeley, Ann. and Mag. Nat. Hist. 10: 380. 1843.

*Hydnum brunneo-leucum* B. & C. Trans. Linn. Soc. **22**: 129. 1859.

Plant pileate, subsessile, horizontal, reddish yellow; pileus round to reniform, concavo-convex, very thin, 2–3 cm. wide, 3 cm. long, less than 0.25 mm. thick when dry; surface glabrous, even, reddish ochraceous to chestnut-brown, or dark blood-red toward margin, whitish puberulent near point of attachment; margin thin, reflexed, crisped; hymenial surface pale to reddish ochraceous; stem scarcely evident, 3 mm. wide, broadening to a disc-shaped foot on the substratum about 6 mm. in diameter, whitish puberulent; substance fleshy, subgelatinous, subbrittle when dry; teeth short, minute, straight, terete, conical, subciliate, reddish ochraceous with pale tips, scarcely visible to the eye, decurrent to the base 125–160 $\mu$ long by 35–50 $\mu$ wide, 9 and 10 to one millimeter; spores not observed.

HAB.: On dead wood. Aug.

RANGE: Louisiana, *Langlois;* Cuba, *Wright.*

ICON.: Berkeley, *loc. cit. pl. 10. f, 8, a, b, c.*

Swartz's type specimen was from the West Indies. Berkeley says: "Swartz described the smooth outer surface of the pileus as the hymenium." I find no evidence in Swartz's descriptions that such was the case. He makes no mention of a hymenial or spore bearing surface, the essential characters of which were probably beyond his means of analysis, and I think he merely got the plant turned upside down in which position it closely resembles a cup-shaped peziza in form, color, and consistency.

The description given above has been made from dried specimens whose characters have doubtless changed somewhat from the fresh plant. On none of the specimens examined was I able to detect any spores. The plant needs to be carefully studied and more fully described from fresh material.

*Hydnum brunneo-leucum* B. & C. appears to be only a poorly developed form of *G. flavum.*

## LIST OF EXSICCATI

The following exsiccati have been examined in the preparation of this paper:

1. **Allescher** and **Schnabl**: Fungi Bavarici.
2. **Cavara**: Fungi Longobardiae Exsiccati.
3. **Cooke, M. C.**: Fungi Britannici Exsiccati.
4. **Desmazieres, J. B. H. J.**: Plantes Cryptogames de France.
5. **de Thümen**: Mycotheca Universalis.
6. **Ellis, J. B.**: North American Fungi.
7. **Ellis, J. B.**, and **Everhart, B. M.**: North American Fungi, Second Series.
8. **Ellis, J. B.**, and **Everhart, B. M.**: Fungi Columbiani. See Shear.
9. **Fautrey, F.**: Herbier Cryptogamique de la Cote-d'Or (France).
10. **Herpell**: Sammlung präparirter Hutpilze.
11. **Krieger**: Fungi Saxonici.
12. **Mougeot, J. B.**, et **Nestler, C.**: Stirpes Cryptogamae Vogeso-rhenanae.
13. **Rabenhorst**: Fungi Europaei.
14. **Rabenhorst-Winter**: Fungi Europaei.
15. **Ravenel, H. W.**: Fungi Caroliniani Exsiccati.
16. **Ravenel, H. W.**: Fungi Americani Exsiccati.
17. **Roumeguere, C.**: Fungi Gallici Exsiccati.
18. **Roumeguere, C.**: Fungi Selecti Exsiccati.
19. **Shear, C. L.**: New York Fungi.
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VOL. XII NO. 3

# STUDIES IN PLANT REGENERATION

BY

ELSIE KUPFER

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# Studies in Plant Regeneration

By Elsie Kupfer

Owing to the great divergence of opinion as to the phenomena to be included under the head of "plant regeneration," the experimenter must consider, at the outset, which interpretation of the term he is willing to accept. In the narrowest sense — that held by Němec,* Pfeffer,† Prantl‡ and Frank§ — only those cases ought to be designated by this name in which the new parts formed after injury or loss exactly resemble in number and position the organs that have been removed. From this point of view, "true" regeneration in the higher plants, except for scattered instances, must be limited to the restoration of embryonic tissue in root and shoot. At the other extreme, the school consisting of Vöchting,‖ Goebel,¶ Klebs** and Morgan,†† use the words to comprehend even the development of buds present on the part before injury. Under this latter aspect, therefore, regeneration is only a phase of normal vegetative growth.

Both of these interpretations seem to a certain extent open to criticism. The former definition would too sharply separate closely related occurrences. For example, to consider as a regeneration the new tip formed on the root of a seedling, as a result of cutting off one or two millimeters of its length,‡‡ and to exclude as such the roots formed from the stem of the same seedling upon the removal of the whole root, seems rather an arbitrary discrimination. Even in animals, where the reproduction of the organ in

* **Nemec, B.** Studien über die Regeneration. 2 *seq.* 1905.

† **Pfeffer, W.** Physiology of Plants (trans. by A. Ewart), 2: 167.

‡ **Prantl, K.** Untersuchungen über die Regeneration des Vegetationspunktes an Angiospermenwurzeln. Arb. bot. Inst. Würzburg 1. 1874.

§ **Frank, A. B.** Die Krankheiten der Pflanzen. Zweite Auflage, 89. 1895.

‖ **Vöchting, H.** Über Organbildung im Pflanzenreich. Bonn 1878.

¶ **Goebel, K.** Organographie 42. 1900; also Über Regeneration im Pflanzenreich. Biol. Centralb. 22. 1902.

** **Klebs, G.** Wilkürliche Entwicklungsänderungen bei Pflanzen. Chap. V. 1902.

†† **Morgan, T. H.** Regeneration. 71. 1901. ‡‡ **Prantl, K.** *l. c.* 21.

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its original condition is the rule and not the exception, cases are known where the regeneration takes place at some distance from the wound, and at an angle to it, and yet the validity of the formation as a true regeneration is undoubted.* In any case where one or more organs are formed as a result of injury or loss, directly at the cut or at a distance from it, they should reasonably be considered as regenerated structures.

On the other hand, the word regeneration ought to be limited to those cases in which an organ is formed, *de novo*, at a place or under conditions in which it would not normally be found. It is in this respect that it seems best to draw the line between regeneration and ordinary growth and reproduction. Such an understanding of the process would exclude phenomena like the growth of latent root and shoot rudiments of cut willow twigs (which Vöchting, Morgan and Klebs place under the head of regeneration), the development of the shoot-meristems on separated leaves of *Bryophyllum* (which Goebel includes here), and the growth of the cotyledonary buds of the bean described by McCallum.† It is undoubtedly true, as each of these writers points out, that gradations between the two types of organ-formation exist, and that the conditions which bring about the development of a preformed bud may be very similar to those which occasion the generation of a new one. It has, furthermore, been proved that such development or formation may be caused without wounding. Nevertheless, it seems logical that, for an accurate understanding of the circumstances controlling organogeny, only such objects should be chosen for investigation as show at the beginning of the experiment no trace of the structure in question.

In the following experiments, therefore, an attempt has been made to obtain some further information as to the behavior of such budless pieces. As it is not always easy to determine positively whether or not primordia are present, there may be cases in the ensuing discussion where the distinction has been unintentionally overlooked; and there certainly are one or two instances where, for the sake of securing evidence on other points, the question as to the absence or presence of such buds has been purposely

* **Morgan, T. H.** Regeneration, 31.

† **McCallum, W. B.** Regeneration in Plants. Bot. Gaz. 40: 97. 1905.

disregarded. On the whole, however, the aim has been to separate such cases of pure regeneration from those which ought to be interpreted under the broader head of correlation.

The work was started at the propagating houses of the New York Botanical Garden three years ago, and has been in progress since. Unless a statement to the contrary is made, the experimental material which belonged almost exclusively to the higher plants, was placed in the cutting-frame in the experimental house and observed at short intervals. This frame is of the usual type, containing pure sand to a depth of about 6 inches, and covered by a partly whitewashed glass top. It may be added that in numerous instances the cuttings were tried, also, in other environments — saturated air, sphagnum, sawdust, charcoal, cotton, and water. But in all of these, the parts decayed with far greater rapidity than in the sand, and few positive results were obtained under other cultural conditions.

The writer desires to acknowledge indebtedness to Dr. D. T. MacDougal under whose direction and encouragement the work has been carried on, to Professor H. M. Richards for many helpful suggestions, and to Professor W. J. Gies for assistance on the chemical side of the experiments. Thanks are due also to the staff of the New York Botanical Garden, who have throughout provided every facility in their power for the successful completion of the work.

---

Various questions presented themselves for solution at the very outset of the work. To decide whether every budless part of the plant is equally capable of regeneration, the separate plant organs have been used as cuttings, and their behavior is described under the heads of *roots*, *stems*, *leaves*, *inflorescences*, and *fruits*. The question as to the rigidity of the polarity manifested by such pieces has been considered with the cases in which any irregularity has occurred. In a similar manner, the effect of external conditions has been treated both in connection with the special instances and as a general subject in the discussion following the experiments. With the object of ascertaining whether food is to be regarded as a necessary factor in regeneration, or whether the parts can, as has been stated, regenerate even under conditions of starvation, a further

set of experiments has been conducted; and finally, existing theories as to the cause of the kind of organs produced in regeneration have been discussed in the light of these and other experiments with a view of determining their plausibility.

## REGENERATION IN ROOTS

Roots afford excellent material for the study of regeneration because, while in many plants the roots normally produce buds, in a number of others, there is a marked tendency to form shoots only upon injury. Vöchting * showed conclusively that in cuttings of woody roots (poplar, *Paulownia*, elm, etc.), new roots are formed at the apical, and shoots at the basal (proximal) end of the part. The same polarity is normally manifested in root-pieces of *Taraxacum*, used by Goebel,† Wiesner,‡ and Küster || and of *Scorzonera hispanica* (Rechinger,§ Goebel¶); though experiments have shown that this polarity could be partially reversed. For example, Wiesner succeeded in inducing shoot-formation from both ends of a *Taraxacum* root-cutting by a culture in light. Goebel demonstrated also that when the growth at the shoot-pole is arrested by a covering of sealing-wax or plaster, or when the callus is repeatedly cut off at this end, the distal end produces the shoots. It is noticeable, however, as Tittmann ** remarks, that the polarity is simply changed at one of the two poles; and that no case is known in which *both* poles produce the opposite type of organ from the normal.

In the work on roots several distinct types were used. Of these the horseradish (*Roripa Armoracia*) was chosen to begin with; this series of experiments was followed by one on the sweet potato (*Ipomoea Batatas*) and dahlia (*Dahlia variabilis*), as examples of thickened secondary roots; a number of fleshy tap-roots, carrots

* Über Organbildung im Pflanzenreich 1: 84 seq.

† **Goebel, K.** Allgemeine Regenerationsprobleme: Flora **95**: 400. Erganzungsband 1905.

‡ **Weisner, J.** Die Elementarstruktur und das Wachstum der lebender Substanz. 112. 1892.

§ **Küster, E.** Pathologische Pflanzenanatomie. 170. 1903.

|| **Rechinger, C.** Untersuchungen über die Grenzen der Theilbarkeit im Pflanzenreich: Abh. zool.-bot. Ges. Wien **43**: 310. 1893.

¶ **Goebel, K.** Über Regeneration im Pflanzenreich. Biol. Centralb. **22**: 1902.

** **Tittman, H.** Physiologische Untersuchungen uber Callusbildungen an Stecklingen holziger Gewächse. Jahrb. wiss. Bot. **27**: 168. 1905.

*Daucus Carota*), turnips (*Brassica Rapa*), salsify (*Tragopogon porrifolius*), radish (*Raphanus sativus*), and parsnip (*Pastinaca sativa*) were next used; and as an example of a woody root, *Pelargonium radulum* was selected. In these roots, attempts were first made to determine whether the part had any power to regenerate, then to solve the question of the tissues involved, and finally to secure evidence as to the action of external conditions and polarity in producing the structures.

Rechinger * used the root of the horseradish (*Roripa Armoracia*) to determine the minimal size of the piece capable of regeneration. The horseradish has on its surface, at the indentations left by the emergence of the secondary roots, little swellings. To these the name "buds" cannot be strictly applied, because, though the cells are rich in protoplasm, and evidently are "embryonic" in nature, there is no vegetative point as such present before growth begins. This develops, however, within a few days after planting the roots or using pieces as cuttings. The shoots thus formed, therefore, would not be classed under true regenerations, according to the definition. A transverse piece of the root, not more than 1.5 mm. in height was found by Rechinger to be capable of forming a new plant. As to longitudinal sections, he says, "Ist noch eine Sprossanlage vorhanden, so wird dies bald ausgebildet; sind nur das Cambium und die Gefässbündeln vorhanden, so kommt es über die Callusbildung nicht hinaus." He goes on to show, further, that when such slices pass through the rind, between the epidermis and the cambium ring — thus cutting the bundles which branch out to the buds — new shoots are formed at these intersections without previous callus formation.

In confirming these results, some additional information as to the regeneration in the roots of horseradish was secured.

*Experiment* 1.— A large number of transverse pieces about 18 mm. in height were used as cuttings. Many of these, besides developing the buds already present on the rind, formed shoots *de novo*, from the cambium of the upper or lower surface indifferently, and occasionally from both. Usually when shoot-buds are already present on a cutting, their development precludes the production of others. Here, although in some cases such sections

* **Rechinger, C.** *l. c.* 322.

of 18 mm. had three healthy shoots already considerably advanced in development, they nevertheless gave rise to additional buds as outgrowths from the cambium (Fig. 1). Beyerinck * as well

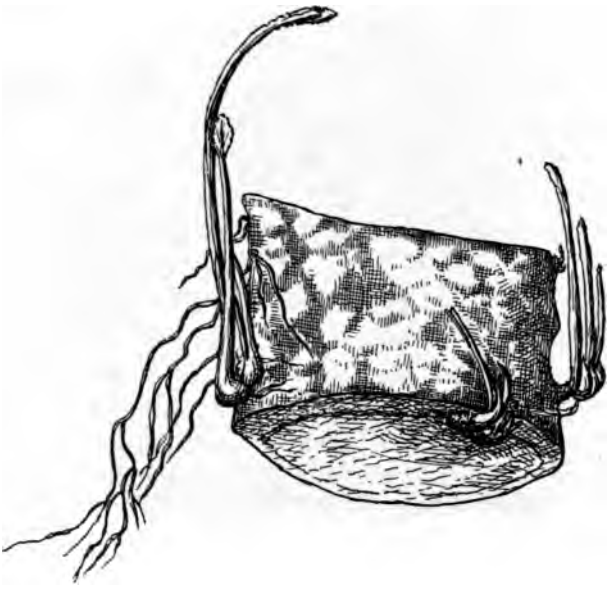

FIG. 1. Root-cutting of *Koripa Armoracia* showing a shoot regenerated from the cambium of the lower surface, besides lateral shoots developed from preformed buds on the rind.

as Rechinger stated that no regeneration takes place when the primary rind is cut away. The following experiment shows that this is not necessarily the case.

*Experiment 2.* — From a number of roots of horseradish, the rind, cortex, and cambium layer were removed. The part left, consisting of only the fundamental tissue and the bundles which are scattered through this, was cut up into slices averaging 20 mm. in height and 12 mm. in diameter. After four weeks shoots developed in the neighborhood of the scattered bundles, and more often at the distal end than at the proximal (Fig. 2). A callus of a few layers of cells preceded the formation of the shoot. In this case, therefore, the root can actually regenerate, in addi-

* **Beyerinck, M. W.** Beobachtungen und Betrachtungen über Wurzelknospen und Nebenwurzel, 52.

tion to developing the rudiments already formed. The power of forming the shoots lies in the cambium at the cut, and in the callus formed as a result of the injury, when no cambium layer is present. It will also be noticed that the tendency to produce shoots at the apical end of a horseradish root-cutting is at least as strongly marked as that operative at the basal end.

FIG. 2. Central tissues of root of *Roripa Armoracia*, from which the rind and cambium were cut away. Shoot-buds have appeared in several places.

In the sweet potato (*Ipomea Batatas*) and dahlia (*D. variabilis*) we have examples of thickened secondary roots which develop shoot buds between growing seasons, but care was taken that none should be present in the parts used in the experiments. The cuts made were similar to those described in the horseradish.

*Experiment 3.* —Transverse sections of sweet potatoes between 2 mm. and 3 mm. in height were placed underneath the level of the sand. Although a large number of these pieces grew moldy and decayed at once, a small proportion continued healthy and in 22 days produced roots. Many of these roots were true regenerations, inasmuch as they did not arise from the cambium and grow outward, after the manner of normal secondary roots, but appeared in the middle of both lower and upper cut surface. Microscopical examination showed that a callus of about four layers of cells had been formed on each surface whence the roots took their origin. The parts decayed without shoot-production.

*Experiment 4.* — The rind in which the buds appear was next removed from six of the tubers, and the pared parts were planted. Again roots were produced in numbers, but no shoots were formed in the four months before the cuttings decayed.

*Experiment 5.* — The converse of this experiment was also tried. Thin rind pieces, without visible buds and as far as possible freed from underlying tissues, were covered with sand. These also rooted within two weeks, but during the two months in which the parts remained intact, no shoots appeared. Therefore none of the parts of sweet potato in which shoot-buds were lacking ever regenerated such buds in these experiments.

*Experiment 6.*—Dahlia root-pieces cut in an exactly similar way have practically failed to regenerate. The transverse slices and the rind-pieces have developed lateral roots as outgrowths from the cambium. Parts from which the rind is lacking have not formed any organs. The production of shoot-buds from the rind is to be looked for, since it is a normal occurrence in the plant, but no instance has yet been observed.

As the next type of root, the fleshy tap roots of several plants were used; from these the leaf-bearing portion was removed, and the rest planted either as one piece or in sections.

*Experiment 7.*—A number of these which gave like results may first be mentioned together. Roots of carrots (*Daucus Carota*), turnips (*Brassica Rapa*), radishes (*Raphanus sativa*) and salsify (*Tragopogon porrifolius*) all produced secondary roots, as in the uninjured condition, but none gave rise to a shoot. The carrots and salsify formed calluses at the upper exposed ends, but although the carrots resisted decay for over five months, and the others for varying lesser periods, no further organ-formation took place.

*Experiment 8.*—Parsnips, however, afforded material for more extended experiments. Transverse sections of parsnips of various lengths were planted with the upper surface above the sand level. Calluses formed in two months' time on both ends. Shoots, it was found, could originate from the callus at either end; but, in the majority of cases, the apical end, underneath the sand, proved to be the surface active in their formation. In only six out of twenty cases did parts planted in the normal position regenerate shoots from the proximal end. One of these produced in addition a weak shoot from the apical end, and one from a cut made in removing a side branch which the root had possessed.

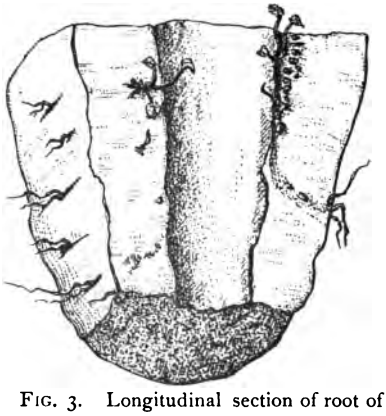

FIG. 3. Longitudinal section of root of *Pastinaca sativa*. Shoots have been regenerated along the cuts.

*Experiment 9.*—Similar parts were next planted in an inverted position. In this case, the shoots

after 58 days all appeared on the basal surface — again the one under the sand.

*Experiment 10.* — Longitudinal sections of parsnips, laid in a horizontal position in the frame, developed shoots in the neighborhood of the cambium along both sides (Fig. 3). These pieces, therefore, resembled *Scorzonera hispanica*, as described by Goebel,* in forming shoots along the longitudinal edges. When placed vertically, the shoots originated only from the apical regions, as was seen to be the usual procedure in the transverse pieces.

*Experiments 11 and 12.* — The separate regions of the root were next isolated, as far as possible, in order to determine their capacity for independent regeneration. The rind alone, when used as a cutting, formed a callus on the lower surface towards the inside, from which shoots arose after 64 days (Fig. 4). Roots

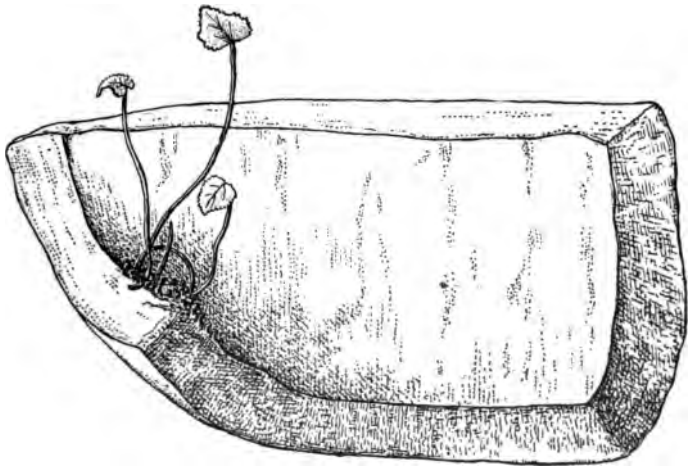

FIG. 4. Rind portion of *Pastinaca sativa* from the inside of which shoots have arisen.

grew from the outside as in the uninjured parsnips. When the central cylinder alone, also exclusive of the cambium, was planted, a callus again appeared at the apical end. From this in four weeks' time, several roots grew. No roots developed elsewhere in this piece, nor were shoots formed. Each region, therefore, is

*Goebel, K. Über Regeneration im Pflanzenreich. Biol. Centralb. 22: 492. 1902.

capable of forming organs, but to a different extent. While the cortex can produce both kinds of structures — one as the result of regeneration and the other in the normal manner — the callus formed by the pith is able to originate roots only. This was the only case where roots formed from a callus in the parsnip.

The foregoing results indicate a close relation between shoot-formation in the parsnip and the action of some external factor, probably water. Vöchting has indicated that moist sand affords a complex of conditions, of which the water, and the contact with a hard substance are two. How the latter could prove active here is inconceivable. It is only for lack of any other evident cause, however, that one is willing to ascribe the difference in the behavior of the two surfaces to the greater amount of moisture in the sand. The air in a cutting-frame, while not saturated, is never dry, and amply suffices for shoot-formation in other instances. There are no other grounds, moreover, for considering water in liquid form as a usual factor in the production of these organs. The experiments that naturally suggest themselves as more definite approaches to the solution of the problem — such as growing the parts in a saturated atmosphere, or entirely below the sand, or in sterilized water, or covered on both sides by moist sphagnum, cotton, or filter paper — were tried without success. None of the parts so treated resisted decay long enough to regenerate. Pieces have recently been set up from which rectangular portions have been removed, thus giving an upper and a lower surface under the sand, but sufficient time has not yet elapsed to yield results.*

As an example of a woody root, *Pelargonium radulum* was chosen because of an accidental observation resulting from another experiment. A leaf-cutting had been made, which rooted freely and produced a shoot from the end of the petiole. The new shoot, in turn, formed a large root-system of its own. In removing the young plant from the sand, after it had been growing five months, its root was broken, part remaining in the frame. From this residual piece, three months later, a new shoot grew up, which turned out, upon investigation, to have arisen from the middle of the up-

* Beyerinck (*l. c.* 65) also found that the apical surface of this root seemed predisposed to form shoots. He offers no explanation, however.

per surface of the piece. Accordingly, an attempt was made to secure a repetition of the result through experiment.

*Experiment 13.*— The roots of several of these plants had forced their way through the openings at the bottom of the pots in which they were planted and had grown down into the gravel of the bench in the greenhouse. These were removed from the plants and used as cuttings. Up to the present time, in all which have regenerated, the procedure has been the same as that mentioned above. The shoots have all appeared from the middle of the pieces (Fig. 5). Specimens have recently been found in which some of these roots, while still on the plant, had sent up shoots. The gardener in charge says that this occasionally happens in this and other plants when the roots are "pot-bound."

FIG. 5. Root cutting of *Pelargonium radulum* which has regenerated a shoot from the middle of the piece.

In all the root-parts experimented with, secondary roots grew out rapidly, sometimes in a few days, or at most within a period of two weeks. These roots are not to be regarded as true regenerations inasmuch as their production is independent of injury. Nevertheless their almost universal occurrence serves to contest an inference reached by Vöchting in regard to both roots and shoots — that the different plant parts give rise to unlike structures with considerably more ease than to like structures. The results in root-cuttings and, as will be seen presently, in other plant parts as well, point to a different conclusion. The establishment of roots, both at places in which they normally occur, and as "adventitious" organs is a far more general and rapid phenomenon than the replacement of shoots. Less than half the kinds of roots used — and care was taken that all should be rich in a

supply of food for expenditure in organogeny — formed any shoots; and in those which did, the appearance of roots antedated that of shoots by a period varying from two weeks to five months. This fact will be referred to later on.

Another point that deserves attention here is the lack of a rigid polarity in the root-parts mentioned. In none of the species in which shoots were acquired anew were these restricted to the basal end. In the horseradish the cambium of either or both surfaces proved active; in the parsnip the end in contact with the moist sand seemed commonly more effective in regenerating shoots, without regard to gravity; and in the *Pelargonium* these arose from the middle of the root. Furthermore, in one of the two cases in which roots were in the narrower sense regenerated, that is, in the thin transverse sections of the sweet potato, these developed from both sides. The evidence, therefore, seems to warrant the conclusion that polarity evinced by root-pieces without buds is less fixed than is generally believed.

## REGENERATION IN STEMS

With the exception of internodes, parts of stems from which buds are absent have been little used in studies in regeneration. This may be because investigators have concerned themselves almost exclusively with the question of root-development on stems. In the stumps of some trees, though, the power to produce shoots from a callus derived from the cambium is a phenomenon very well known but not readily subjected to experiment. Nevertheless, some stems afford abundant scope for experimentation as to shoot-production. Experiments have been carried on with dicotyledonous stems, modified stems of various types, monocotyledons and a conifer. In the dicotyledonous stems, of which *Muhlenbeckia platyclados* and *Phyllocactus* (sp?) were taken as one type, aerial shoots of potato as a second, and the potato-tuber as a third, the first point upon which information was sought, was the behavior of stem-pieces of considerable size from which the buds had been cut. A comparison of such regeneration with cases in which one or more buds had been left was also instituted; and finally the regeneration of the internode alone was investigated.

*Muhlenbeckia platyclados* is well suited for the first purpose because of the ease with which the regions concerned in bud-production can be removed. The stem is a flat jointed organ without functional leaves in the adult condition, but with scales occurring in two orthostichies at alternating edges of the septa. From these regions roots appear when parts of the stem are planted. There are, however, no "root buds" in the sense in which the words are used for willow and poplar twigs.

*Experiment 14.* — Oblique cuts were made above and below the scale-bearing portions of the nodes so as to excise these together with any rudiments which might be present. The stems were then cut into pieces on October 29, 1905, and planted. On December 31, all had formed a slight callus on the basal cuts and roots had grown out from these. In one case a wound had been made in the lowest internode, and also a longitudinal slit just above the first node. From both of these regions additional roots appeared. Cuttings of this sort remained alive and healthy for over sixteen months and produced a richly-branched root-system, but no new shoots (Fig. 6). During this time no change in form or secondary thickening of any kind took place. This is all the more unusual, in that, as will be seen later, when a single bud was left on the piece, such thickening was plainly visible.

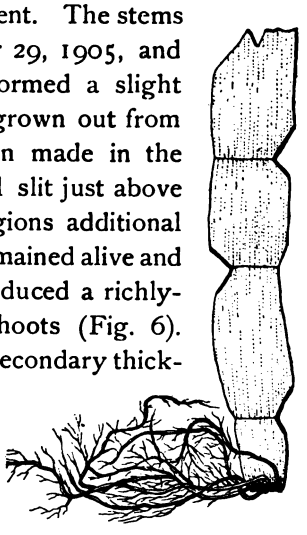

FIG. 6. Stem of *Muhlenbeckia platyclados* from which the buds were cut away. It regenerated only roots.

*Experiment 15.* — Eleven pieces similarly cut were planted in an inverted position. Seven of these failed entirely to root. The others produced a few roots, but never from the cut end of the internode. In these the roots came from the morphologically upper diagonal cut. The inverted pieces, probably because they had fewer roots also dried up after several months without having formed shoots.

*Experiment 16.* — To determine how far inward from the corner of the node the root and shoot-forming "impulse" extended, longitudinal slices of from 2 mm. to 4 mm. were cut from one edge of pieces from whose opposite side the scale-bearing

region had been removed in the manner just described. These pieces were placed in a horizontal position in sand, with the straight edge down. In seven of the nine pieces thus placed, roots developed as in the erect pieces, from the cut end of the basal internode. The other two produced several small roots from the nodes on the straight side. One of the seven in which the cut end of the internode bore the roots, produced these as well from an oblique cut on the notched side of the stem, which was in the air, but not far above the ground. When eight pieces like those just mentioned were placed with the notched edge under the sand, in all cases, again, the basal internode developed roots, and in two pieces the upper oblique cut produced them as well.

These experiments prove, it seems to me, that the organ-forming "tendency," as it may be called for the present, in this plant does not extend very far in from the edge of the stem. When, by means of the deeper cuts, all the region which is ordinarily active in this formation is removed, the roots are formed, not at the nodes, but only at the basal cut. On the other hand, when less has been lost, or when the oblique cuts have not excised all of this region, the organs may be formed as well or exclusively at these points. Moreover the inability of the parts to form shoots after they have been removed indicates the very narrow limits within which this regeneration takes place.

*Experiment 17.* — On November 4, 1904, on one piece of *Muhlenbeckia* stem, the diagonal cuts were made along one edge, removing the buds, while the other edge was left uninjured. The whole side which had one bud present was placed in the sand. Roots developed from one of the lower uninjured nodes, and from the basal internode. The former were removed and did not grow out again. A shoot, however, developed from the axillary bud. On October 15, 1905, the piece was taken out and examined. It was found that the shoot had established a direct connection with these basal roots by means of a secondary growth of vascular tissue through the middle of the old stem (Fig. 7). On section, it was found that from interfascicular cambia new bundles had been formed between the old in this restricted portion. The number of bundles intercalated between the old ones was most often two, but in places, one or three; and these bundles ran continuously from

roots into the new shoot. The thickening was much more pronounced on the upper side than on the lower.

The *Muhlenbeckia* stem, as it develops from the cutting or ing, is round and leaf-bearing; but it very shortly widens out the flat, thin, leafless organ, characteristic of the species.*

IG. 7. Cutting of a stem of *Muhlenbeckia platyclados* in which the bud estab- a secondary vascular connection with the regenerated root.

mparison between the round and flat portions of such a young shows that the number of bundles is approximately the same e two, and that the difference in surface is accounted for by

**Hildebrand, F.** Einige Beobachtungen an Keimlingen und Stecklingen. Bot. o: 2. 1892.

the increased amount of tissue between the bundles in the flat part. As the plant grows older, these flattened parts again become cylindrical. In this case the subsequent rounding-off is caused by the interpolation of new bundles between the old, so that eventually a continuous ring is formed, which thereafter widens from the cambium in the usual manner. The difference between this growth and that shown in the specimen of Fig. 7 is at once apparent. In the normal thickening, the whole stem changes its form, and the new bundles are formed at an equal rate in all parts. In the regenerated specimens, however, only about a third of the stem took part in the change, while the rest remained flat and unthickened as before. Even in the rounded part the new bundles had formed unevenly, so that every little elevation was visible on the reverse side from that shown in the figure. The unthickened edges would probably have been split off, in time, and growth would have continued regularly. Signs of such a splitting were just visible when the plant was removed for preservation. This behavior is also to be contrasted with that of the specimens from which all buds were cut (*Exp. 14*). Though the latter were growing for a period very nearly as long as the one just described, no secondary thickening took place. Evidently the presence of a growing point in some way regulates even a growth in diameter.

The stem of *Phyllocactus* resembles that of *Muhlenbeckia* in being flat and leafless. In other respects also, this plant recommends itself for the same series of experiments as the latter stem. Here only a very narrow triangle of tissue needs to be cut from the edge of a node in order to excise the normal bud-producing region. The bulk of the stem thus remains intact, and is able to continue its work of photosynthesis as before.

*Experiment 18.* — Portions of stems of *Phyllocactus* (sp.?) were subjected to incisions at the nodes similar to the ones described for *Muhlenbeckia*. When placed in an upright position they also produced the roots only from the lower cut surface. There is in these flat stems a rounder thicker central strand which is sometimes referred to as the "midrib." Most of the roots took their origin from the cut end of this strand, though an occasional root came from the flattened part. No shoots appeared. Laterally

placed pieces with buds cut out have behaved in all respects exactly like the erect pieces.

In order to obtain information as to the behavior of the aerial shoots of the potato, before and after such excision of the axillary buds, experiments were set up in which at first only the basal bud and then progressively more buds were taken away until finally the cuts included the growing points of the stem.

*Experiment 19.*—The tops of such shoots, always exclusive of the lowest three internodes, were planted. The leaves were removed from the portion below the sand level. The parts rooted quickly but sparingly from the end of the internode; but when these roots were rubbed off, as frequently happened in taking up the cuttings for examination, no new ones formed. Notwithstanding this, the lowest axillary bud, which had been present at the beginning of the experiment as a small green rudiment in which the leaves were just visible, after five weeks became changed into a small tuber. This grew right up against the stem without any visible stolon.

*Experiment 20.* — The buds at all the nodes under the sand level were next removed. Roots were produced, as before, and at the first node above the earth a tuber was formed on a short stalk. It became green through exposure to the light, and the small leaves could be seen on it. When the leaf remained attached, a sessile tuber was formed in the axil.

*Experiment 21.* — In this series only the buds at a few of the apical nodes were allowed to remain. Again at these nodes, stalked tubers grew which were 15 cm. above the sand.

*Experiment 22.* — Finally all the buds, including the terminal buds, were excised in twenty-two pieces. Roots again formed, but in no case did a shoot regenerate. The pieces remained in the sand two and a half months but were not able to produce either a side branch or a tuber at any point.

The results are significant from several points of view. They show the ease with which a tendency present in a part may be shifted to another when its manifestation is rendered difficult at the usual place. Normally it is only a few of the lower nodes from which tubers are produced. Moreover, the experiments yield additional instances of tuber-formation in the light, which has been

recently discussed by Vöchting,* Gager, † and others; ‡ and finally no better illustration could be cited of the difference in the reactions of parts possessing buds and parts deprived of them.

Regeneration in budless parts of potato-tubers was carefully worked out by Rechinger.§ He succeeded in inducing the formation of a shoot from cubes 4 cm. in diameter cut from the center of the tuber. He traced the origin of the scanty callus formed to the cambial strands which ramify through the stem, and showed that the shoot always arose in the neighborhood of such a callus. When he removed the "eyes" of the potato and cut the remainder into halves or quarters, shoots formed on the cut surfaces. Some experiments performed before the writer had learned of Rechinger's work may be worth mentioning, as they showed some slight differences from his results.

*Experiment 23.* — From a series of potatoes, the buds, together with approximately 1 cm. of underlying tissue were removed. After a period varying considerably on the different occasions on which the experiment was performed, buds appeared on one of the surfaces exposed by cutting out the original buds. The "reaction-time" in these cases varied from thirty-six days to five months, and one potato lived fourteen months without regenerating or decaying. This variation was independent of the season of the year, as was proved by the fact that great differences were observed in similar seasons of recurring years. Nor was it slowest in the fall and quickest in February, as might have been expected from the normal sprouting habits of uninjured potatoes. The differences were doubtless due to the fact that no one variety of potatoes could be secured for all the experiments, and that no definite information could be obtained as to the names of the varieties purchased.

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* **Vöchting, H.** Über die Keimung der Kartoffelknollen. Bot. Zeit. 60: 86. 1902.

† **Gager, C. S.** Tuber-formation in Solanum tuberosum in daylight. Torreya 6: 181. S 1906

‡ Knight (Phil. Trans. 1806) found that when the tubers were pinched off from the lower nodes, as they appeared on the plant, these were formed above ground, in the light. As far as I know, however, the behavior of cuttings in this respect has not before been recorded.

§ **Rechinger, C.** Verh. zool.-bot. Ges. Wien 43: 315. 1893.

*Experiment 24.* — Parts with eyes removed in the manner described were cut into halves and quarters like Rechinger's and planted with the cut end down. These formed shoots, though not, as in Rechinger's results, at the large cuts, but in the region of the original bud. In no case was a shoot found on such a cut.

*Experiment 25.* — Pared potatoes as wholes and in parts were next tried, but although some of these resisted decay for four months, no shoot ever appeared.

*Experiment 26.* — The buds formed on the potatoes of experiments 23 and 24 were repeatedly removed, but new ones continued to form, sometimes in the same place, sometimes at a different node. If the parts were left undisturbed, shoots finally appeared at many of the nodes as in the uninjured tubers. No polarity could be observed in the appearance of the buds. They were formed with apparent indifference at any of the cut regions, without reference to apex, base, dorsal or ventral surface. No roots were formed in the specimens under observation. Modified stems of other types — thorns, tendrils, and rhizomes from which the buds were removed did not regenerate.

Internodes differ from the type of stem described above chiefly in their smaller size, but also in the fact that all the nodal tissues in addition to that directly concerned in the production of the bud has been lost. Apparently for this reason, they disintegrate with far greater rapidity than the larger pieces. Only in the case of certain of the begonias have records of shoot-formation in internodes been met with. The results to be indicated re-emphasize the rarity of this occurrence.

*Experiment 27.* — The internodes of a series of plants regenerated in a manner similar to *Heterocentron diversifolium* described by Vöchting,* in that they gave rise to roots at the base, but not to shoots. Internodes which yielded this result belonged to *Muhlenbeckia platyclados*, *Phyllocactus*, *Vitis quadrangularis*, *Hedera helix* and *Bryophyllum calycinum*. Internodes of a large number of other plants decayed without regeneration.

*Experiment 28.* — Internodes of *Muhlenbeckia platyclados* were placed in inverted positions in the sand. On one piece, in the first trial, roots appeared, but the suspicion arose that it had been

* Über Organbildung, etc., 72.

accidentally restored to its original position. In none of the twenty-seven pieces in which the apical end had been marked for identification did roots develop. A very slight callus was formed, but this soon went over into cork-formation. Normally, then, these inverted internodes do not root.

*Experiment 29.* — A similar result was obtained from two inverted internodes of *Vitis quadrangularis*. Lack of material prevented further work on this plant.

Monocotyledonous stem pieces without buds were generally found to give negative results even as regards root-formation. This may be due to the absence of a cambium to initiate callus-formation, but, on the other hand, it is well known that callus may originate from almost any parenchymatous tissue. The failure to root was probably due to an unfortunate choice of material for experimentation. One monocotyledon, however, gave an interesting result. The "pseudobulb" of the orchids is morphologically a short, thickened stem consisting of one or several internodes, in which growth ceases after a single season. In *Dendrobium Parishii* the pseudobulbs usually have four such internodes.

FIG. 8. Pseudobulb of *Dendrobium Parishii* which has formed roots and a shoot at the base.

*Experiment 30.* — One of these stems two years old was placed in sand on November 4, 1904. On February 18, 1905, the presence of roots of the aerial type at the base of the cutting was discovered, and the part was transferred to peat. By October 15, 1905, a new shoot had appeared, also at the base. The single leaf characteristic of the species was plainly visible (Fig. 8).

Because of the well-known difficulty in inducing conifers to root,* cuttings were made of seedlings of these plants and of stems of plants in their fourth year.

*Experiment 31.* — When the entire root was removed from seedlings of *Pinus Laricio*, a callus was formed after four weeks at the end of the hypocotyl. From this in seven out of the nine cases in which organs were formed, a single root, occu-

* **Sorauer, P.** Handbuch der Pflanzenkrankheiten, II Auflage 1 : 663. Also Populäre Pflanzenphysiologie für Gärtner, 169. 1891.

pying the whole of the cut surface, was regenerated (Fig. 9, *a*). Thus the seedling was "restored" to its original condition. Sections showed that most of the callus formed had gone directly over into the formation of the one root. A few rows of cells on the side,

FIG. 9. *a*. Seedling, and *b*, older stem cutting of *Pinus Laricio*. In both a single root regenerated from the callus of the cut surface.

however, which were not so used, showed that another root might have been formed therefrom if there had been space for its development. In the other two cases, two roots were formed from the beginning. Prantl * and Simon † mention instances in

* **Prantl, K.** Untersuchungen über die Regeneration des Vegetationspunktes an Angiospermenwurzeln. Arbeit. Bot. Inst. Wurzburg 550. 1874.

† **Simon, S.** Untersuchungen über die Regeneration der Wurzelspitze. Jahrb. wiss. Bot. 40: 116. 1904.

roots, where, after the removal of a piece from the tip of between 1 mm. and 2 mm., a single root may form from the cut instead of more, as is common. No case has been found by the writer in which a single organ is recorded as coming from the stem, when all of the root had been cut off. Here the sympodial character of the regenerated organ becomes obscured and the seedling externally resembles the uninjured one in all essentials.

*Experiment 32.* — The stems of each of the three-year-old plants of this pine were cut into four pieces and planted. All of these produced slight calluses, but in the two lower sets no roots formed, even when the callus was again wounded. One of the apical pieces, however, formed a root directly from the stem above the callus — a phenomenon that has been often observed in other instances; and in one of the second set, as in the seedling, a single root appeared from the middle of the callus which grew so as to occupy the entire cut surface, again restoring the plantlet to its original condition (Fig. 9, *b*). Thus there seems to be a tendency in this pine to form only one root from the callus produced as a result of injury. Not many instances of this restoration in adult tissue are known.

The great majority of plants with aerial stems (the beech is the best known exception) — are capable of being propagated from stem-cuttings. It is, therefore, instructive to reflect that this power, is, in at least a large percentage of cases, due entirely to the presence of shoot-buds on the part before the cutting is made. This is not universally true. The cut-stems of poplars, elms, and other trees are known to develop shoots from a callus on their apical cut ends; and Vöchting obtained shoots from the internodes of *Begonia discolor*.* But in most cases, when such buds are removed, the stems seem to be incapable of replacing them, and the cuttings fail to establish themselves as plants. The behavior of such parts serves to emphasize the principle that while unfavorable external conditions may prevent a normal regeneration or cause a change in its position, even the most auspicious culture conditions fail to induce such a formation when the internal impulse is lacking.

* *L. c.* 78.

## REGENERATION IN LEAVES

Leaves are organs which usually upon removal from the plant, without further incisions, are freed from connection with preformed rudiments. A few (*Bryophyllum crenatum* and *Leptaxis Menziesii*) have normally such primordia, which had to be detached before the leaves could be included in the limits of the present work. Besides a repetition of the experiments with normal leaves as wholes and in parts, the behavior of modified leaves of different types has been investigated; among the latter figured thorns, phyllodes and so-called "juvenile" leaves. In connection with the regeneration of the bean leaf, an anatomical study of callus and root-formation in this species was undertaken; and, finally, the power of *Leptaxis Menziesii* to replace its bud after its removal has been re-examined.

Of eighty-two species of green leaves used as cuttings only a very small proportion needs recording. The majority conform in their method of producing root and shoot — or, more often, the former only, to the descriptions given everywhere in botanical literature.* Vöchting,† in his discussion on the behavior of these organs, expressed the opinion that the leaf in which the power to regenerate a new plant is lacking, would, upon investigation prove to be the exception, rather than the rule. This has not been borne out by the following experiments. In all of the sixty-one species which gave any positive results, roots were formed, while only twelve kinds gave rise to shoots. All of the latter, with the exception of *Piper canescens* had been known before to have this property, so that out of 71 species in which the regenerative power had not been recorded, only one was discovered which was able to produce a new plant.

In 1816, Knight ‡ planted in earth the leaves of the potato, expecting them to root and to form tubers at the base. He was surprised that neither of these things happened, but that the end of the petiole swelled up, and was found to contain material like that in the tuber. (*Exp. 33.*) Consequently the ease and regularity

* For literature see **Vöchting** *l. c.* 92 *seq.*

† *L. c.* 97.

‡ **Knight, T.** On the action of detached leaves of plants. Phil. Trans. 289. 1816.

with which potato leaves so planted produced roots and, for a long time nothing else, caused the writer some astonishment (Fig. 10, *a*).

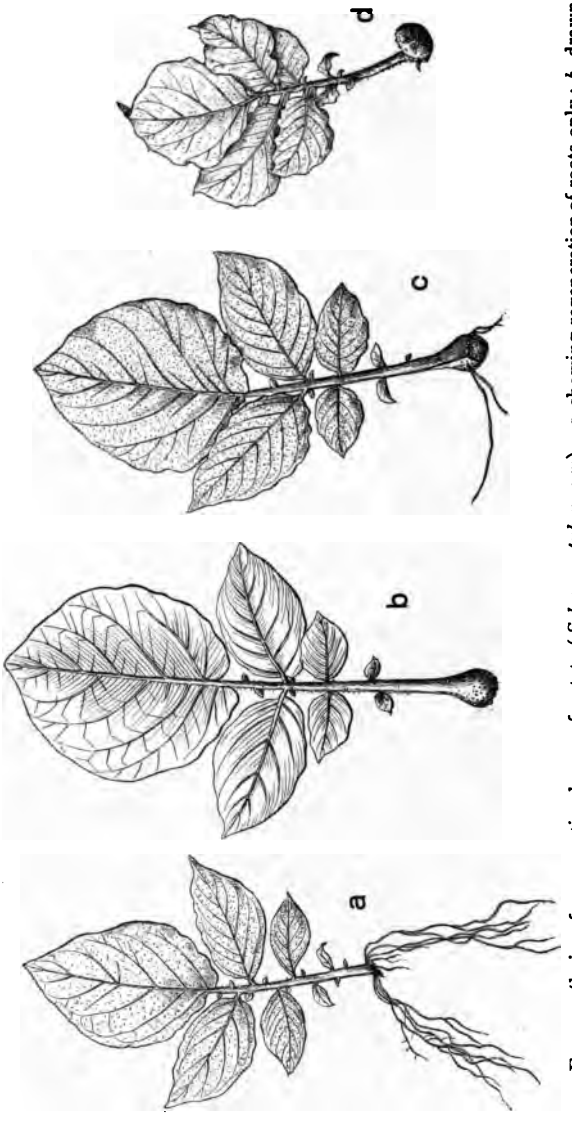


FIG. 10. Series of regenerating leaves of potato (*Solanum tuberosum*). *a*, showing regeneration of roots only; *b*, drawn from the under side showing swelling at the end of the petiole containing starch; *c*, swelling and roots present; *d*, with true tuber at the base.

At last a series was found in which the phenomenon described by Knight recurred (Fig. 10, *b*). Several leaves showed gradations between this type of regeneration and the preceding one in that

they possessed both the tuberous swelling and roots (Fig. 10, *c*). And, as a climax one leaf has been discovered in which neither the roots nor the swelling appeared, but an actual tuber on which buds are visible (Fig. 10, *d*). All these leaves were taken from the same plant and subjected to apparently identical conditions.

*Experiment 34.*— When the petiole of a leaf is largely or entirely cut away, roots form additionally or solely from the under side of the lamina. This occurs, for example, in *Begonia Credneri*, *Peperomia argyrea*, *Iresine Herbstii*, etc. Roots may also be called forth by extra transverse cuts in the blade, and in *Euphorbia nivulia* by longitudinal cuts. Parts of leaves used as cuttings behaved just like those described by Vöchting and his predecessors; but in no case was an isolated petiole found to form shoots.

*Experiment 35.* — To determine whether leaves had any power of rooting from the apex, the tip was removed from blades of various species of *Begonia*, *Echeveria*, *Sedum* and *Pelargonium*, and from *Bryophyllum* leaves from which the buds had been cut out, and the leaves were planted with the apical end down. In order to prevent evaporation from the exposed end of the petiole, this was covered with paraffin. Some of the leaves remained turgid for five months, but none ever rooted in this position.

The abnormal increase in the size and thickness of regenerating leaves has been noticed by DeVries * and Lindemuth,† and has recently been worked out in careful detail by Mathuse.‡ The same phenomenon attracted the writer's attention and measurements were being taken when Lindemuth's paper appeared. His results and Mathuse's fail to confirm a statement made by DeVries that the life of a leaf when planted is not noticeably prolonged beyond its duration on the parent plant. Lindemuth's rooted leaves in some cases lasted five years and were then sacrificed for anatomical study. As further evidence that this statement is not universally true the following experiments with leaves which have a noticeably short lease of life on the plant may be mentioned.

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* **DeVries, H.** Über abnormale Entstehung secundärer Gewebe. Jahrb. wiss. Bot. **22**: 35. 1891.

† **Lindemuth, H.** Über Grosserwerden isolierter ausgewachsener Blätter nach ihrer Bewurzelung. Ber. Deut. Bot. Ges. **22**: 171. 1904.

‡ **Mathuse, O.** Über abnormales sekundäres Wachstum von Laubblattern, etc. Bot. Centralb. Beiheft. **20**: 174. 1906.

*Experiment 36.* — *Euphorbia nivulia* is a xerophyte which is leafless except at the growing apex. In the plants that have been under observation in the greenhouse, moreover, these new stems bear leaves for only a few months in the year. When planted, however, the leaves lived for over fifteen months in the sand. At the end of that period, while still in a healthy growing condition, they were transferred to a pot of fertilized soil in an attempt to induce shoot-formation. Very shortly after the transfer the entire pot and its contents unaccountably disappeared.

*Experiment 37.* — *Muhlenbeckia platyclados* also has leaves which are found only in the "juvenile" condition and form part of the plant for only a very limited period (see Fig. 7). Yet upon being placed in the sand, they also rooted and maintained themselves for several months, though not so long as *Euphorbia nivulia.*

Küster * makes a statement that thick leaves form calluses very readily, as a rule, while thin leaves or those containing a great deal of water usually produce only a very weak callus. For this reason, he continues, cotyledons usually are richer in this respect than later leaves. This has not proved to be the case with the leaves of the kidney bean (*Phaseolus vulgaris*), lima bean (*Phaseolus lunatus*) or lupine (*Lupinus alba*). The primary and later leaves of the bean, which are very thin, form a larger callus and root more easily than any other leaves which have been tried. Their regeneration takes place with considerably more certainty and rapidity than that of the cotyledons, which very frequently decay without forming calluses or roots. The lupine cotyledons also form weaker calluses and regenerate more slowly than the later leaves.

The leaf of the bean forms a callus within a few days after being planted, and roots develop between the ninth and the thirteenth day. The question as to the point of origin of such roots has been much discussed. Stoll,† disputing a statement made by Cruger‡ that roots could arise either in the callus or above it, maintained that the callus formed no vegetative points, but that

* **Küster, E.** Pathologische Pflanzenanatomie 168. 1903.

† **Stoll, R.** Über die Bildung des Kallus bei Stecklingen. Bot. Zeit. **32** : 736. 1874.

‡ **Cruger, H.** Einiges über die Geweberänderungen bei der Fortpflanzung durch Stecklinge. Bot. Zeit. **18** : 369. 1860.

these always originated in the pericambial region above its level. Wiesner * and Hansen,† however, have confirmed Cruger's results and there is no doubt that organs may arise in both ways. The pulvinus of the primary leaf of the bean was cut off, so as to simplify the anatomical study, and the leaves were planted. Every twenty-four hours up to the ninth day on which, in some cases, roots became visible, specimens were removed and killed. Microtome sections showed that the callus-formation begins in the cortical region just outside the bundles on the second day. There may be several centers of such formation in the rind, which start independently but later unite. On the fourth day activity is noticeable in the pith cells, as well, of which there are a few rows surrounding the cavity of the hollow petiole. The callus resulting from the growth in these two regions eventually, about the seventh day, covers over the entire cut end of the petiole so that the hollow is no longer visible. Roots may grow out in both of the ways described above. Sometimes the callus remains sterile and the roots appear only from the petiole above. At other times they start in the part of the callus which covers the cavity, so that there can be no question here of a derivation from a cambial tissue at a higher level. The stages in the formation of callus and roots closely coincide with the processes as described by Stoll,‡ Tittman,§ Sorauer || and others, so that there seems no need of a further description here.

*Experiment 38.* — The callus was allowed to form fully, and was then cut off on the eighth day. Others were repeatedly removed after the same lapse of time, and it was found that a single leaf could form eight such calluses before it disintegrated.

*Experiment 39.* — Bean leaves which had formed calluses and roots were transferred to a rich loam, to a soil saturated with culture solution, and to a one per cent solution of grape sugar, to

* **Wiesner, J.** Die Elementarstruktur und das Wachstum der lebender Substanz 94. 1892.

† **Hansen, A.** Vergleichende Untersuchung über Adventivbildungen im Pflanzenreich. Abh. Senckenb. Naturf. Ges. 12 : 157 *seq.* 1881.

‡ **Stoll, R.** *l. c.* 752 and *pl. 12.*

§ **Tittmann, H.** Physiologische Untersuchungen uber Callusbildung an Stecklingen holziger Gewachse. Jahrb. wiss. Bot. 27 : 164. 1895.

|| **Sorauer, P.** Handbuch der Pflanzenkrankheiten. 2 Auflage 1 : 660 *seq.* and *pl. 13.*

see if a better food supply could induce the production of shoots; but these organs did not develop.

Of a large variety of phyllodia, leaf-thorns, leaf-tendrils and pitchers planted, only *Acacia pycnantha* yielded positive results.

*Experiment 40.* — Its phyllodia used as cuttings rooted with great apparent difficulty after seven months, and subsequently decayed without further regeneration.

A modified leaf of a different type is represented by the bulb-scale. The method of multiplying hyacinth-bulbs by cutting off the base and allowing the separate scales to regenerate, has long been practiced by the Dutch bulb growers.* *Lilium tigrinum* has been found by Beyerinck † to have the same faculty. Other bulbs tried — tulip, oxalis, daffodil — did not exhibit this power. The scales of the hyacinth do not themselves root, but the bud, shortly after it is formed, develops a root of its own.

*Experiment 41.* — Scales of the onion bulb, on the other hand, produced roots with little difficulty, but never gave rise to any buds. In one case an onion gave a very deceptive appearance of rooting from the apex of the scales, as well as from the base. A closer examination, however, showed that the roots had arisen from the base, as usual, but had pushed their way up between the inner epidermis and the mesophyll of the scales emerging at the top.

As an addition to the number of plants in which shoot buds can be induced to form while the leaf is still on the plant may be mentioned *Sedum tortuosum*. This leaf has no preformed rudiments, but can, when removed, form root and shoot in the normal manner at the base. A transverse cut had been accidentally made in the middle of a blade, and when the plant first attracted notice, it had formed a bud at the cut.

*Experiment 42.* — Similar wounds were made, experimentally, and in several cases the bud appeared (Fig. 11). In some, root rudiments were visible on the lower surface, but their development was suppressed by the dryness of the air. Other types of cuts —

* **Fortune, R.** A Visit to the Bulb Farms of Haarlem. Gard. Chron. 556. 1863.

† **Beyerinck, M. W.** Over het ontstaan van Knoppen en Wortels uit bladen. (Reviewed in Bot. Centralb. 14 : 112. 1883.)

longitudinal, tangential, and transverse cuts from the under surface, have failed to call forth any regeneration.*

Wakker † divides leaves which regenerate into those in which buds are normally present in the life of the leaf, and those in which they are absent. He says that if the buds are removed

FIG. 11. Shoot of *Sedum tortuosum* showing a bud at a transverse cut in a leaf.

from the leaves of the former type — of which *Bryophyllum* is the best known example, they cannot be replaced. The results of an operation of this sort on *Leptaxis* (*Tolmiea*) *Menziesii* show that this is not universally true.

*Experiment 43.* — The buds which are situated at the point of junction of the blade and petiole of these leaves were removed with a very sharp small scalpel from twelve specimens, so that no visible trace of these remained. Then the leaves were placed in the sand. They rooted plentifully both from the preformed rudiments at the back of the petiole, near its insertion, and from new

* An interesting fact (which is well known in other instances) was illustrated by this plant. Though it had been readily propagated from stem and leaf cuttings, and had been placed provisionally under the name of *Sedum aureum*, the plant had never been known to flower. In the regeneration experiments, practically every leaf was wounded in one way or another; as a result a flower stalk appeared, and the probable identity of the species was discovered.

† **Wakker, J. H.** Onderzoekingen over adventieve Knoppen. (Reviewed in Bot. Centralb. 32: 238. 1887.)

ones at its base. Furthermore, after four or five months in three of the leaves a new bud developed in the same position as the original. When the buds were burnt out with a platinum needle or with acid, the neighboring tissues were so seriously injured that no regeneration took place.

In leaves and their parts, then, as has been seen, regeneration takes place with ease and some regularity, though there is no active cambium layer as such to initiate the organogeny. The latter process, as was seen to be the case with budless pieces of stems, and some roots, is very often confined to the production of roots, though in many well-known instances both kinds of organs are formed. When this occurs, there is seldom a structural connection effected between these organs, but the shoot alone forms an independent plant. Even with roots only, the leaf can perform all the functions necessary for its maintenance, and can survive, at least at times, for a period longer than its normal duration on the plant.

## REGENERATION IN INFLORESCENCES

Few cases are on record of regeneration in inflorescences. Beinling* found roots on inflorescence of *Echeveria*, Sorauer† obtained regeneration in flower-stalks of *Primula sinensis*, Hansen,‡ in *Achimenes grandis*, and Goebel § records it for *Klugea*, *Naegelia*, *Ajuga* and *Tussilago farfara*. In the last, Goebel || mentions that the regenerated shoot-bud arose from the axil of one of the lowest green bracts of the stalk, but this does not seem to be the case in the others.

*Experiment 44.* — The tall inflorescence of *Dudleya californica* was divided into three parts, all of which were planted. They rooted from the base, and the middle part in addition formed a shoot bud, which was broken in the removal from the sand, and

* **Beinling, E.** Untersuchungen über die Enstehung der adventiven Wurzeln und Laubknospen an Blattstecklingen von Peperomia. Cohn's Beitr. Morphologie 3 : 30. 1883.

† **Sorauer, P.** *l. c.*, 657.

‡ **Hansen, A.** Vergleichende Untersuchungen über Adventivbildungen bei den Pflanzen. Abh. Senckenb. Naturf. Ges. 12 : 179. 1881.

§ **Goebel, K.** Über Regeneration im Pflanzenreich. Biol. Centralb. 22 : 502. Au 1902.

|| **Goebel, K.** Allgemeine Regenerationsprobleme. Flora 95 : 404. Ergansungsband 1905.

which did not appear again in this or in either of the other parts. In a similiar trial with peduncles of *Bryophyllum crenatum*, only the lowest of the three parts rooted, and no shoot was produced.

*Experiment 45.* — *Ruellia rosea* has an inflorescence of a different type. The peduncle is green and slightly flattened, without leaves. In the seventeen months in which the parts remained alive, they regenerated an ample root-system, but nothing further.

## REGENERATION IN FRUITS

Few instances of regeneration in fruits have been recorded. In some of these the fruits are of the type of *Opuntia* where the stem is incorporated in the fruit.* Roots have also been reported on the capsule of *Lilium speciosum*.† Two additional green fruits proved, in these experiments, to have the faculty of producing roots.

*Experiment 46.* — Half-grown pods of yellow bush bean and lima beans were placed with their pedicels in sand. From the end of this stalk a callus was formed, and roots grew through this in three weeks (Fig. 12). In only one or two cases did the regenerated organ enable the pod to mature its seeds. Ordinarily the ripening was effectually prevented by the processes of decay which set in shortly after the roots were formed and eventually killed the part. Roots sometimes started from the stem above the callus, instead of growing through it, so that it is to be presumed that both sorts of origin are possible here as in the leaf. It must be admitted that this kind of regeneration is fundamentally like that of an inflorescence. That there is a difference, however, was shown by the following comparison.

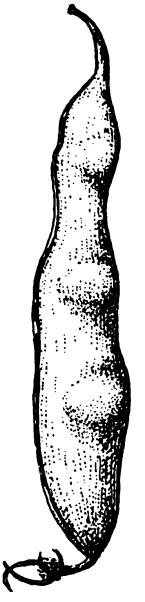

FIG. 12. Pod of *Phaseolus*, which has formed a callus and roots from the end of the pedicel.

* **Vöchting.** *l. c.* 110; also **Hildebrand, F.** Über Bildung von Laubsprossen aus Bluthensprossen bei Opuntia. Ber. Deut. Bot. Ges. **6**: 109. 1888.

† **Carrière, E. A.** Un Fruit qui s'enracine. Rev. Hort. **49**: 207. 1877.

*Experiment 47.* — Bean flowers on their pedicels were placed in the frame beside the half-mature pods. The former always died without regeneration, while the pods rooted easily. The difference is doubtless to be ascribed to the smaller amount of material available for regeneration in the flower than in the fruit.

*Experiment 48.* — When the pedicel is cut off, or pulled off, and the pod alone is planted, it succeeds in forming a small callus, but no roots. There is, however, little doubt that such a part has the power of producing roots and that better manipulation will make this manifest.

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The foregoing experiments have demonstrated that every part of the plant, even when preformed rudiments are absent, has some power of regeneration, though in a majority of the cases this is not complete enough to establish a new plant. One fact, furthermore, is brought into undoubted prominence as a result of the experiments, with so few exceptions that these are practically negligible. This is, that the disposition for root-formation is much more widespread throughout the plant and more easily energized than the power to produce shoots. The proportion of parts which formed only roots to those in which both sets of organs were regenerated was as 74 : 20. It has been seen, too, that where both kinds are produced, the roots usually precede the shoots by a period of time varying from three weeks to seven months. Only three instances were found in which the cuttings regenerated shoots alone — the potato-tuber, the central tissue of the horseradish-root and the hyacinth bulb-scale. In a certain sense, however, even these parts might be said to share in the production of roots, for the regenerated shoots almost immediately after they themselves become visible, form root primordia. On the very youngest buds of the potato these are present, and become developed before the shoot is further differentiated. The converse has never proved true in these investigations.* In the case of the *Pelargonium* leaf-cutting (*Exp.* 13) a shoot did spring from the root. However, this shoot was not the first one formed; it appeared only after a lapse of seven months and as the result of a second injury. An attempt at an

* Though Vöchting and Beyerinck state that it is often the case in woody roots of trees.

explanation for this phenomenon involves a consideration of the various theories of regeneration, and may, therefore, be deferred until this subject is discussed.

The experiments throw some light also on the dependence of organogeny upon the presence of a cambium, and upon callus formation. That the structures regenerated do not necessarily derive their origin from a cambium, as Stoll,* Frank,† and their followers assert, has been demonstrated by the results with isolated root-regions from which the cambium has been carefully cut away, and from the anatomical study of the bean petiole. It will be recalled that the central part of the parsnip, consisting only of wood and pith, was able to produce a callus and roots. Root-meristems, too, were seen to arise in the callus covering the hollow of the bean petiole. And, as to shoots, isolated rind-tissues of the parsnip were found to produce a callus from which buds arose (Fig. 4). The absence of any cambium or transverse bundles in this region was confirmed by a microscopical examination at the time the buds appeared. Coulter and Chrysler found a similar development of shoots from isolated cortical regions of *Zamia.*‡ There can be no doubt, therefore, that both roots and shoots may arise from callus that has no direct connection with cambium or bundles. That both sorts of organs can also spring from a cambium without the intermediation of a callus seems equally clear. Rechinger § describes such a derivation of shoots in the horseradish, and of course the origin of roots in such a manner is a common occurrence. The cells of both these tissues agree in being undifferentiated, rich in protoplasm, and capable of rapid division — three characteristics which seem to supply the structural basis for the appearance of primordia of root and shoot.||

Before closing this section of the work, it may be worth while to record the result of an experiment performed on the alga *Penicillus capitatus* in the summer of 1904 at the Flatts Harbor in

*L. c.*, 761.

† **Frank, A. B.** Die Krankheiten der Pflanzen 1 : 70.

‡ **Coulter, J. M.**, and **Chrysler, M. A.** Regeneration in Zamia. Bot. Gaz. 38 : 452. 1904.

§ **Rechinger, C.** *L. c.*, 323.

|| A few instances are known, as for example in the epidermis of *Begonia* leaves, where organs arise from mature cells without even the intermediation of a callus.

Bermuda. The "shaving brush," as the alga is popularly called, is a siphonaceous form in which stalk and head are made up of branching filaments without cross walls. The stalk is encrusted with lime, but the filaments of the head are soft and flexible.

*Experiment 49.* — The "heads" of a number of these algae which were growing in the sand on the bottom of the harbor were cut off, and the algae were marked for identification. After 38 days it was found that a new head of loose filaments had begun to form (Fig. 13). On microscopic examination it appeared that the cut ends had closed over and the filaments had gone on branching in the normal manner. This alga, then, adds another to the list of the Siphoneae which have a considerable power of regeneration.

FIG. 13. *Penicillus capitatus.* After the "head" had been cut off a new one was formed.

The position and character of the new organs which appear on a part in regeneration have been accounted for in a great many different ways. Some of these influences are to be found in the external conditions to which the part is subjected, others in qualities and tendencies inherent in the part before injury. Though it has generally been assumed that an available food supply, either as stored nutriment or as the product of the photosynthetic activity of the cutting, is a *sine qua non* of regeneration, few attempts have been made to confirm this fact by experiment. The necessity of food has, indeed, been recently denied by McCallum.* He found that pieces only 8 mm. long of the stems of bean seedlings from which the cotyledons had been removed, could, even when kept in the dark, develop the buds present in the axils of cotyledons; and Morgan, calling attention to the similar phenomena described in regard to animals, has declared that the parts may regenerate even under conditions of starvation.

The following experiments performed on various parts have led to a different conclusion.

*Experiment 50.* — A plant of *Begonia Rex* was kept in the dark for two days. Four leaves from this plant were then cut in-

* **McCallum, W. B.** Regeneration of Plants. Bot. Gaz. 40: 105. 1905.

to pieces of which an equal number were left in the light and in the dark for 17 days. At the same time portions of the leaves were preserved for microscopical examination. Both sets of specimens regenerated roots and shoots in that time, those in the light being noticeably larger. This result would fall in line with the one described by McCallum and might warrant the deduction that the regeneration is independent of food. The error of the conclusion, however, lies in the fact that there was still a considerable amount of starch in the leaf at the time of cutting. Sections made of the parts which had been preserved showed starch grains scattered throughout the leaf, but collected sometimes in large numbers in the neighborhood of the veins. This material, therefore, doubtless served as the basis for regeneration.

*Experiment 51.* — Leaves of a plant of *Begonia Rex* which was darkened for four and one half days were next treated in the same manner. Sections showed still a few isolated starch grains, so that even after this lengthy exclusion from the light, not all the food previously made had been consumed. However, in this case the difference between the two sets of parts was marked. All those subsequently exposed to the light formed roots and shoots normally, while the ones in the dark decayed without regeneration.

*Experiment 52.* — The same result was obtained with leaves of a bean plant that had been darkened only 48 hours. Without light the leaves did not form even a callus; when set in the light, calluses and roots formed, but more slowly than normally. These results seem to indicate, therefore, that regeneration does not usually take place in the piece during starvation. Consequently the question naturally arises as to whether food actually was lacking in the stem-parts used by McCallum.

To confirm the result as to the effect of the absence of light, parts were also placed in an atmosphere devoid of carbon-dioxide.

*Experiment 53.* — The materials used were leaf-portions of *Begonia Rex*, of two species of *Peperomia* and of *Pelargonium* which had all been darkened four days before the beginning of the experiment. These were placed underneath a bell-jar from which the carbon-dioxide was removed in the usual manner. None of the parts regenerated. The experiment was not so conclusive as the preceding ones, however, inasmuch as the apparatus had not been

set up so as to allow a renewal of the oxygen. Still as a large bell-jar had been used to cover the cuttings which themselves were small, it is probable that the amount of oxygen would have sufficed for regeneration had other conditions permitted.

Further evidence of the dependence of regeneration upon either a reserve food-supply or the ability of the part to make food was afforded by white shoots of various plants.

*Experiment 54.* — In the variegated *Commelina* (sp?) among the shoots with green leaves and with green and white striped leaves, occasional shoots appear on which all the leaves are pure white. Such white shoots were used as cuttings and compared with shoots having striped or green leaves. Whereas the latter rooted within a week or ten days, the white pieces in repeated experiments unanimously failed to regenerate. The results obtained with *Commelina* were reinforced by the behavior of white shoots of *Oplismenus Burmannii* (the *Panicum variegatum* of the gardeners), of *Pelargonium* (Madame Solleroi), and of some white orange seedlings which appeared as sports in the greenhouse. In none of these species was the white shoot able to form roots. If, however, the leaves on the shoot contained even a very narrow green area (*Commelina*, *Pelargonium*, *Oplismenus*) the organs were produced.

It may be argued here that such parts are in a pathological condition, and that the failure to root was due to other causes than the absence of a food-supply. White variegation is believed to be caused by an oxidase,* which when present in quantity prevents the formation of chlorophyll in the chloroplast. Except for this absence of coloring matter, however, the cells of the white shoots showed no microscopical difference from the normal ones. They were as rich in evenly distributed cytoplasm, and their nuclei were apparently similar. Moreover, the fact that the possession of a single green stripe only 1.5 mm. wide enabled the shoot to regenerate seems to point forcibly to the conclusion that it is primarily the lack of the food manufactured by the chlorophyll which prevented the shoot from rooting. When this green stripe was darkened, as was done crudely by coating it with India ink, the regeneration, while not prevented, was delayed for from 4 days to a week beyond the average time.

* **Woods, A. F.** The Destruction of Chlorophyll by oxidizing Enzymes. Centralb. Bakt. Parasitenk. und Infectionskrankheiten 5 : 745. 1899.

*Experiment 55.* — Attempts to supply the lack of this nourishment by growing the pieces in various dilute sugar and peptone solutions repeatedly failed. In only one case did a shoot of *Commelina* grown in a one per cent sugar solution, form a root 4 mm. long. In all the other trials, though attempts were made to keep down the number of bacteria by frequent change of the solution and by the addition of small doses of copper sulphate, the parts decayed without giving positive results. It does not seem at all unlikely that with better culture methods this regeneration may be more often induced.

The foregoing experiments indicate, therefore, that normally the leaf or shoot has at the time of cutting sufficient reserve food to initiate the first stages of regeneration. When, however, this food is absent and its formation is prevented either by external conditions or by the parasitic habit of the part, regeneration is inhibited. Given the necessary food supply, the question next arises as to what other conditions are responsible for the appearance of the organs in regeneration. Vöchting in 1878 gave the answer with regard to external influences which all subsequent experiment has failed appreciably to alter. In an exhaustive series of investigations on the effect of light, gravity, water, pressure, and contact, Vöchting came to the conclusion that while external conditions may have a modifying or an arresting effect on the place of the appearance of the organs, these could not be considered as primarily the causes of regeneration.* As was before mentioned he ascribed the practically uniform position of the structures formed on root and shoot-cuttings as due to an inherent force in the plant which he termed "polarity." The fact that leaves fail to exhibit this polarity, but form both kinds of organs from the base, he explained as due to the limited growth of the latter organs as contrasted with the unlimited growth of root and shoot.

His conclusions have not found universal acceptance. Instances have been recorded where — as for example in *Bryopsis* † — the root-pole could, by the action of light, be changed into a shoot-pole and the reverse. In the higher plants, too, numerous cases

*E. g., l. c.* 82.

† **Noll, F.** Über die Umkehrungsversuche mit Bryopsis. Ber. Deut. Bot. Ges. 18 : 444. 1900.

of so-called "reversal of polarity" have been found. When, for example, the production of a callus at the apical end of a poplar stem is prevented by growth in dry air, or by a cap of sealing-wax, the basal callus produces the shoots; and instances of reversal in root-cuttings of *Taraxacum* have been referred to already. The experiments recorded above showed organs in unusual positions in the case of the shoots on the parsnip and horseradish and the roots on thin slices of sweet-potato. Yet, as Tittmann first emphasized, only one pole is ever affected in these results, while the other produces its normal type of organ or nothing.* And, further, though by unusual conditions the position of the regenerated structure has been modified, the piece cannot be said to have altered its polarity; for as soon as it is restored to favorable surroundings, it will produce organs in the normal way. That this "normal way" must have reference to any peculiarities which the uninjured plant manifests has been made clear by some of Goebel's † later work.

Klebs,‡ while admitting the polar tendency in cuttings, as a result of a series of experiments on both uninjured and cut willow twigs, came to the conclusion that this disposition could not be the determining factor in evoking the appearance of the roots. By local application of water he succeeded in inducing the apical end of twigs still on the plant to root; and in cuttings, by varying the temperature at the two ends or by inversion whereby the basal end extended into dry air he found that the roots developed only at the apex. He accordingly states that the real cause of the appearance of the roots lies in the fact that something is supplied which was previously present in insufficient quantity for development. In the case of roots, at least, this necessary factor is a local abundance of water. Roots, he says, normally appear at the basal end of cuttings because here there is a contact with moist earth and an absence of light. He criticises Vöchting's inversion-experiments on the score that in many species of willow the rind is too thick to be easily permeable to water; but if these twigs are partially denuded of bark so as to allow water to enter, an equal number of roots appear at apical or basal end independently of polarity. He con-

* **Tittmann, H.** *l. c.* 167 *seq.*

† **Goebel, K.** Allgemeine Regenerationsprobleme. Flora 95: 405. 1905

‡ **Klebs, G.** Willkürliche Entwickelungsänderungen bei Pflanzen, 96–124. 1903.

cludes that it is "in hohem Grade warscheinlich das jede Polarität umkehrbar ist."

Later experiment has not, on the whole, confirmed Klebs's position. McCallum * showed that roots could be produced even while the part was slowly drying; no amount of water could bring about the formation of roots on the apical end of the *Muhlenbeckia* internode; and as a final answer to this contention Vöchting † has written a recent paper, in which, working with the same plants and using similar methods to those of Klebs, he proved the latter's results and conclusion faulty. He found that when the twigs of this willow were cut into three pieces, all either erect or inverted, the basal piece always produced most roots; that less roots were produced in water than in moist sand; and that freeing twigs from cork was rather a hindrance than an aid to root-production. As a result he re-emphasizes his old position that in the higher plants, at least, polarity is a very stable, probably hereditary characteristic which it is a difficult matter to reverse. Just what the conditions were which caused the unusual position of the organs in the roots referred to above, has not yet been determined.

Goebel in interpreting this polar tendency at first adopted the Duhamel-Sachs "formative stuffs" hypothesis.‡ This theory held that there are in the plant definite root-forming and shoot-forming substances which usually, owing to the action of gravity, flow in different directions. The lighter shoot-forming stuffs flow upward and their aggregation at a cut causes the appearance of a shoot there; whereas the heavier root-forming substances flowing downward account for the growth of roots on such lower ends. However the possibility of a flow of both stuffs in both directions independent of the action of gravity was finally admitted by Sachs to explain the presence of both kinds of organs in tubers and seeds. In Goebel's § later articles, he no longer insists upon different formative stuffs, but believes the phenomena capable of

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* **McCallum, W. B.** *l. c.* 119.

† **Vöchting, H.** Über Regeneration und Polarität bei hohern Pflanzen. Bot. Zeit. **64**: 101–131. 1906.

‡ **Sachs, J.** Stoff und Form der Pflanzenorgane Gesamelte Abh. über Pflanzenphysiologie, **2**: 1159–1200.

§ See Regeneration im Pflanzenreiche. Biol. Centralbl. **95**: 385 *seq.* 1905; also Weitere Studien über Regeneration. Flora **92**: 132 *seq.* Ja 1903.

interpretation without this assumption. The vegetative points of root and shoot normally appropriate the food-material (not further specialized). When the connection with these growing points is interrupted either by mechanically hindering their development or by cutting the conducting system, the material flows to other previously dormant vegetative points and rouses these into activity. The new structures then appear at a nearby meristem if such exists. If a preformed growing point is absent, the heaping up of the food at the base of the interrupted conducting tissue, be it cut vein or the end of the petiole, causes the organs to grow here.

The other factors which have by different writers been considered causal in calling forth regeneration may be briefly enumerated. Noll * regards the form disturbance as the energizing influence; Küster,† the removal of the hindrances to growth; Wiesner,‡ the impulse from the dead cells at the wound to the living cells beyond. In a series of ingenious experiments conducted mainly on the cotyledonary buds of the bean, McCallum § has certainly succeeded in proving that no one of these factors is alone responsible in calling forth the development of these buds, which he regards as regeneration. His work, however, seems open to criticism on the score that he nowhere considers the possibility of two or more of these conditions working in concert to bring about these results; and for that reason his decisions that the "wound-stimulus is not in itself any part of the cause" and that the growth is not brought about "through any disturbance created in the nutritive or water relations" do not carry conviction. To his own conclusion, moreover, that the regeneration is due to the removal of "some influence which an organ . . . is able to exert over other parts and so prevent their growth," the same comment would apply as to the explanations which he criticises. Even when this condition is present, the formation of one or the other kind of organ may fail to take place; and on the other hand, the regeneration may occur without the separation

* **Noll, F.** Über die Körperform als Ursache von formativen und Orientirungsreisen. Sep. Abd. aus den Sitzungsb. Niederhein. Ges. 1900. 1–6.

† **Küster, E.** Pathologische Pflanzenanatomie 276.

‡ **Wiesner, J.** Die Elementarstruktur und das Wachstum der lebender Substanz 102.

§ **McCallum, W. B.** *l. c.* 243, 262.

from the influence of the parts above and below, which he considers necessary. When cuttings are made of stems from which the buds have been excised, the parts are certainly removed from the influence of both growing roots and shoots; yet, except in the potato-tuber, only roots are capable of being replaced. The tuber moreover, though separated from the roots of the plant of which it formed a part, itself does not acquire roots. That this disability is not due solely to correlations as one might think, is proved by the fact that even when the buds (which usually root immediately upon their development) are repeatedly cut away, the tuber is still unable to supply the loss of roots. Accordingly, isolation from either type of organ is not alone sufficient to call forth its production. Furthermore the bud can be induced to appear on the leaf of *Sedum tortuosum* and other plants without such detachment. Here by simply making a narrow transverse cut through the midrib, shoots and sometimes root-rudiments form on the leaves while they still retain their connection with both root and shoot of the growing plant. The same fact proved true of the roots formed both in his own experiments and in those of Klebs.*

As has been shown above, the replacement of roots either as direct restorations or as outgrowths from the cambium of the main or secondary roots ("Ersatzbildungen") is a more generalized faculty throughout the plant than the acquisition of shoots when rudiments are lacking; also when both kinds of organs grow anew the roots have almost always been seen to precede the shoots by a period of time that may be considerable. The explanations of regeneration above mentioned do not account for either of these phenomena. It is undoubtedly true that the aggregation of food at the end of an interrupted conducting system is, as Goebel maintains, one of the factors favoring regeneration. Yet again in the case of the stems with excised buds and in many leaves, though food unquestionably gathers at the cuts, this is not effective in bringing about the development of a shoot meristem. Moreover, in the cases of the inflorescences and fruits which regenerate, whatever current of food material occurs must be upward toward the developing flowers and seeds. Nevertheless, in all the instances

* *L. c.* 103.

in which the regeneration of these parts has been recorded, one or both structures are formed only at the base. This has always seemed to indicate a serious flaw in Goebel's hypothesis.

The teleological explanation of the early and general appearance of roots on nearly all kinds of plant-cuttings is a tempting one. It might seem as if roots formed easily because they are immediately necessary to the life of the part. But though the advantage cannot be denied, it cannot be considered as an explanation of their appearance. In nature, the opportunities for regeneration do not occur in a sufficient number of individuals to allow the faculty to become established by natural selection; and if only roots are formed, as so often happens, even the advantage is only transitory.

Other interpretations which readily suggest themselves also fail to hold on closer scrutiny. It might be thought that the simpler structure of the roots as compared with the shoots would account for the facility with which they are produced; but when a part has had at its disposal during many months building-material enough to construct an elaborately branched root system out of all proportion to the needs of the cutting, the question may well be asked why some of it was not at once expended in the generation of a shoot, which would thus have reproduced the plant. Nor can external conditions here be considered causal, since it has been shown that these may be varied radically with only arresting or slightly modifying differences in the result.

The only recourse, therefore, seems to be to go back to the old formative stuffs idea in perhaps a somewhat altered form. If a part fails to produce a certain organ when food is plentiful, and even massed near a cut, when all relations between the piece and other growing regions are severed, when all hindrances to growth are removed, and when external conditions are at an optimum for such formation, it would seem to indicate that what is lacking is a very definite substance which it is not always in the power of the cutting to supply. In what guise is this substance to be regarded? To assume with Sachs that the sap contains two different materials, one heavy and root-forming which moves downward, and one lighter and shoot-forming which moves upward, owing to the action of gravity, blocks, as Vöchting * has justly intimated, the way to fur-

* Bot. Zeit. 64: 101 *seq.* 1906.

ther investigations on account of the impossibility of detecting such materials, or explaining their flow.

The following theory is offered as a suggestion only, and does not pretend to account for all the phenomena in the field; but as it is to a certain extent approachable by experiment, it may be worth while to present it at this point. Inasmuch as the polar tendency in a plant may be regarded as one of its hereditary qualities, the power to form roots or shoots at any point might be ascribed to the presence at such a place of particular enzymes, which are responsible for the formation of the organ in question. While the fertilized egg-cell would contain both of these enzymes, theoretically restricted to the opposite ends of the cell, this is not the case with the majority of cells resulting from its division. As growth of the plant continues, the shoot-forming enzyme becomes localized at the nodes where buds are being formed, at the growing points of the stem, and (in the case of roots which normally produce buds) in the neighborhood of the emerging secondary roots. The root-forming enzyme, on the other hand, apparently remains a permanent constituent of nearly all cambial cells throughout the plant. If we can remove the product of the activity of the enzyme but leave it behind, the regeneration of the organ becomes possible when food and growing cells are present. This would account for the fact that a vegetative point, when split longitudinally or when cut transversely very near the end, is able to replace directly what is lost; but when the cut, extending a little farther back, presumably removes the enzyme as well, no restoration takes place. Instead a lateral organ produced from some other place where a sufficient quantity of the enzyme is still retained assumes the role of the axial organ which has been lost; or, in the case where shoot-buds are excised from a stem, as practically all this sort of enzyme has been removed at the same time, no new shoots form.

The root-forming enzyme which is, according to supposition, present in nearly all cambial cells is normally prevented from acting by the fact that the growth is hindered by the surrounding cells and perhaps also by the absence of a static food material upon which to act. When a cut is made, however, the stimulus of the wound rouses the enzyme into activity, the food aggregating

here supplies the material, and the organ, no longer hindered by encompassing tissue, makes its appearance. While, as was suggested above, the shoot-forming enzyme is usually restricted in its distribution, it can also sometimes be formed anew when cells which have by differentiation lost this substance, upon injury, resume more or less of their embryonic characteristics, in the formation of a callus.

Our entire knowledge of enzymes and their mode of action is almost in its infancy, but some of the more recent discoveries as to their history and condition of activity may apply here. For example, it is known that an enzyme may be present in a cell not as such but in the form of a pro-enzyme or zymogen which changes into the enzyme upon certain kinds of stimulation. Such might well be taken to be the case in the root-forming enzyme, where the stimulating factor could be the exposure of the cells containing the zymogen to moist air, or this condition in combination with others, such as a change in the pressure relations and the chemical effect of aggregated food. Again, the presence of a substance called a *kinase* is known to enhance the action of an enzyme, and it may be that such a substance, in addition to the enzyme is present at the nodes and vegetative points. Finally, as a third possibility, cases are known where, in company with an enzyme, a compound of an opposing nature, termed an "anti-enzyme" exists, and according as one or the other gains the ascendant the particular effect of the enzyme is manifest or obscured. Some such explanation might account for the individual variations in the regeneration of the same part under like conditions, as for example, the differences observed in the behavior of the potato leaf. However, while the possibility of the existence of such kinds of substances should be considered, it must be admitted that in the present status of our knowledge, they do not very materially aid in the solution of the problem. The detection of such substances is even more difficult than that of the enzyme proper and the expectation of success on their identification or effects in the types of activity manifested by plants must be remote.

As to the enzymes themselves, experiment seems to afford some opportunity for securing information. The method by which evidence as to their presence or absence might be arrived at, is by

making extracts of the organ in question, and injecting these into parts in which they are lacking. A series of experiments with this object in view has been started but no results ready for publication have as yet been obtained. There are certain inherent difficulties in manipulation, which make the success of the operation uncertain; but further work may suggest means of obviating these, or at least of minimizing their influence.

Such an explanation as the one above outlined would not necessarily preclude the action of any of the conditions that have been assigned as the causes of regeneration. It simply indicates that, as the regeneration is lacking in cases for which these theories fail to account, there may be necessary, in addition, specific substances which can be provisionally looked upon in the light of enzymes.

## SUMMARY

1. Every organ of the plant without buds that has been used as a cutting has been found to be capable of a certain amount of regeneration.

2. In the cases of the roots that regenerated shoots, these were not confined to the basal ends of the cuttings, but were found on the apical cut-surface as well (horseradish) or upon the surface which at the time was under the sand (parsnip) or, finally, in the middle of the root (*Pelargonium*).

3. The separate tissue regions of the root exclusive of the cambium were found capable of regeneration. From the central part of the horseradish, shoots were developed, and both the rind and the central cylinder of the parsnip regenerated, though the latter produced only roots.

4. Parts of six other kinds of roots were able to form roots, either as regenerations or as outgrowths through the rind in the normal way, but did not develop shoots.

5. When the bud-producing regions were cut away from a number of stems, these formed roots from the base, but were unable to replace the shoots. Though such parts lived over a period in which, on the plant, they would alter their form and become secondarily thickened, they did not undergo any change when treated in the manner described. In the *Muhlenbeckia*, however, when a single bud was left, such thickening, though of an unusual sort, did occur.

6. If in the shoots of the potato used as cuttings, one bud was left uninjured anywhere on the stem, this developed into an aërial tuber; if all buds were removed, no shoot-formation took place.

7. Budless parts of potato tubers were found capable of forming new shoots on one of the cut surfaces of the nodes.

8. Regeneration of both kinds of organs occurred at the base of the pseudo-bulb of *Dendrobium Parishii.*

9. The production of a single root from stems of the seedlings of *Pinus Laricio* and also from one of the older parts shows that this kind of regeneration externally resembling a "restoration" may take place from stems as well as from the apical ends of roots.

10. The majority of leaves used as cuttings regenerated roots only; but two new cases were found (*Piper canescens*) and the potato-leaf (*Solanum tuberosum*) which were able to form a shoot and thus reproduce the plant. The roots of such leaves can arise either from a callus or directly from the tissue of the petiole. Modified leaves such as phyllodes and bulb scales were also able to form roots.

11. Leaves which on the plant have a very short existence were found able to prolong this considerably when they formed roots.

12. Regeneration of both kinds of organs occurred in the flower stalks of *Dudleya californica*, and of roots in the inflorescences of *Bryophyllum calycinum* and *Ruellia rosea.* The fruits of *Phaseolus vulgaris* and *P. lunatus* also formed calluses and roots.

13. The disposition to form roots is much more generalized throughout the plant and more easily energized than the power to form shoots. Only about one fourth of the parts used produced shoots in addition to roots, and only three produced shoots alone. This power cannot be explained on structural or teleological grounds.

14. The alga *Penicillus capitatus* has the power of replacing the "head" of filaments when this is cut off.

15. Experiments show that regeneration is dependent upon an adequate food-supply. In plants from which the reserve food had been exhausted by a prolonged exclusion from the light, no regeneration took place if the parts were subsequently darkened,

or if the carbon dioxide was absorbed from the atmosphere in which the parts were kept. Entirely white shoots of several species of plants — presumably from their inability to manufacture food — proved unable to form roots even though primordia might be present.

16. Since certain parts fail to regenerate one or the other kind of organs, when each of the conditions previously assigned as the causes of regeneration has been fulfilled, it seems necessary to postulate the existence of specific substances which are responsible for the formation of those organs. These substances have been assumed to take the form of different enzymes which are not present in all the cells of the plant, but are localized in definite places. It is perhaps possible to obtain evidence on the grounds of this assumption by experiments, of which a series has been already started.

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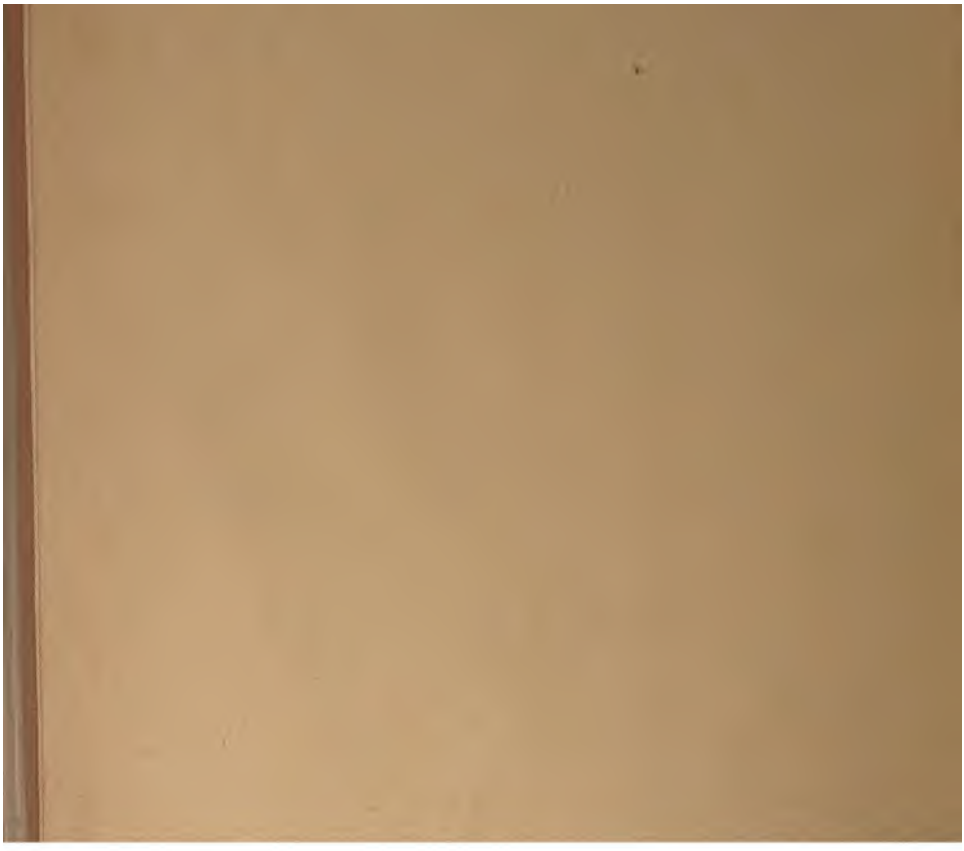

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